1. In 2012, 8.6 million people fell ill with tuberculosis (TB) and 1.3 million died from TB.

(i) Describe how the Mantoux test is carried out to diagnose TB.

---

[2]

(ii) Antibodies are produced in response to the TB pathogen. **Fig. 26.1** shows an antibody.

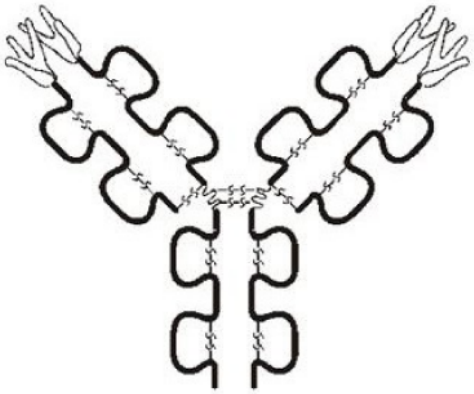


Fig. 26.1

Suggest how the structure of the antibody allows it to carry out its role as an:

agglutinin ---

---

opsonin ---

---

[2]

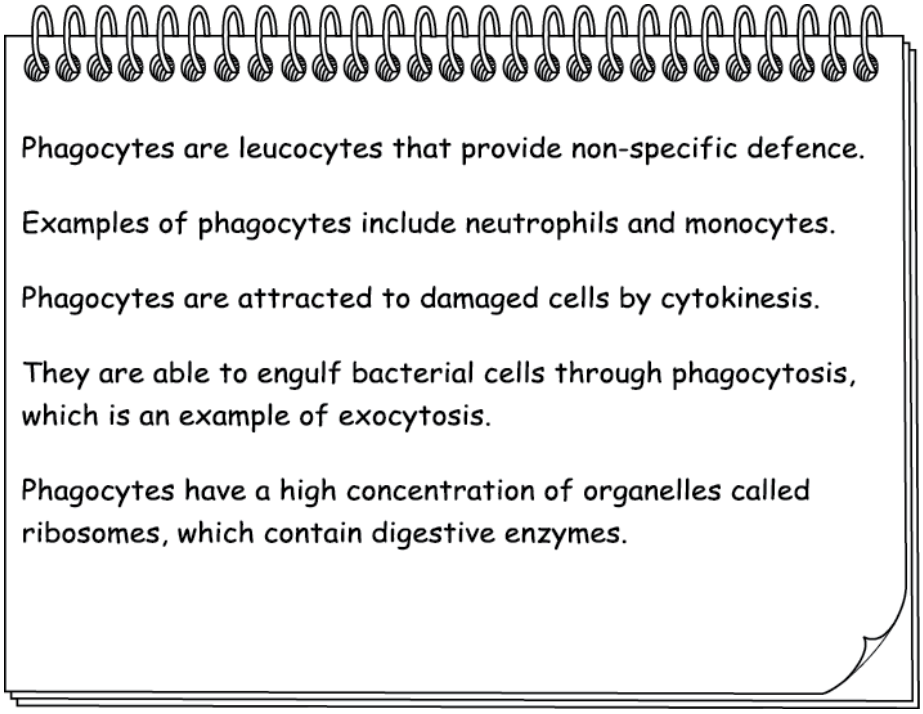
2. Suggest why enzymes must be modified before being injected into the bloodstream.

---

[1]

3. A student is revising the structure and functions of phagocytes with a friend.

The student wrote the following description, but the friend spotted three errors.



Choose **three words** from the description that are errors **and** write a suitable word to replace each error.

1. error _____

replacement word _____

2. error _____

replacement word _____

3. error _____

replacement word _____

[3]

4(a). Listeriosis is a disease caused by eating contaminated food products, such as unpasteurised milk.

The bacterium responsible for the disease, *Listeria monocytogenes*, releases an extracellular protein called p60 which enables the bacterium to invade host cells.

Anti-p60 antibodies have been identified that act as opsonins for the phagocytosis of *L. monocytogenes*.

(i) Explain what is meant by the following terms.

opsonin

---

phagocytosis

---

[2]

(ii) Explain how the production and release of extracellular proteins in mammalian cells would differ from that of p60 in *L. monocytogenes*.

---

[2]

(b). Listeriosis can be fatal. Pre-screening food products for the presence of *L. monocytogenes* or p60 would be of great benefit to public health.

The protein p60 can be detected using diagnostic methods involving antibodies.

Outline the role of antibodies in the detection of *L. monocytogenes* and p60 in food samples.

---

[3]

(c). Antibodies, such as anti-p60, have a generalised structure.

The generalised structure of an antibody is shown in Fig. 23.

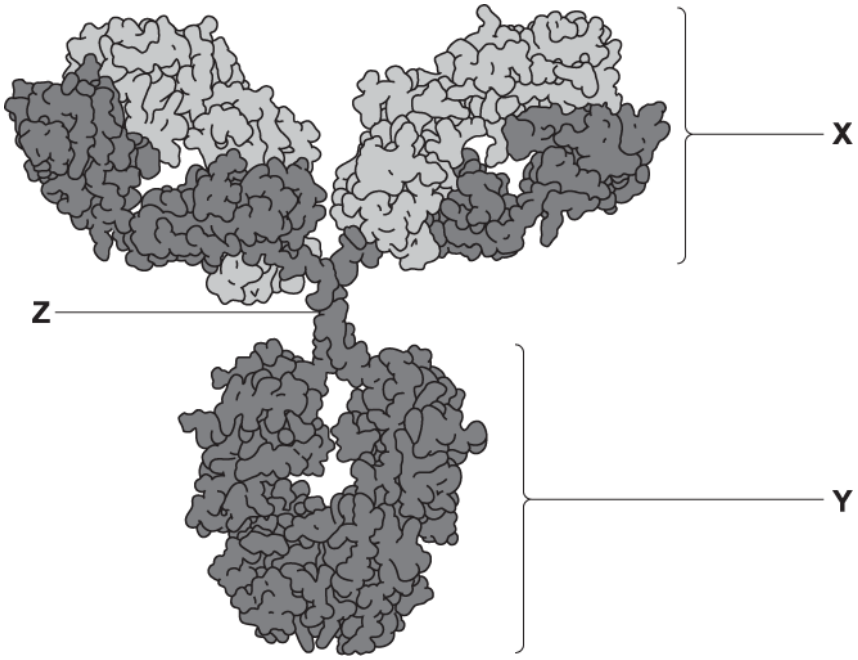


Fig. 23

Name **and** describe the function of the parts of the antibody labelled **X**, **Y** and **Z**.

X

Y

Z

---

[3]

5. *Mycobacterium tuberculosis* is a bacterium that can cause TB.

Screening for TB is done using a Mantoux test.

Explain why a person who has immunity to TB develops a red, raised lump following a Mantoux test.

---

[3]

6. This question is based on the case study '**TB: STILL HITTING THE HEADLINES**' **(Case Study 1)**.

You were told in the case study that Robert Koch discovered the cause of tuberculosis (TB) in 1882.

This discovery led to diagnostic skin tests for TB being developed.

Describe how individuals in the UK are tested for TB today.

---[3]

7. The Polymerase Chain Reaction (PCR) can be used to test a blood sample for the presence of Human Immunodeficiency Virus (HIV).

Stages in the PCR test are listed in Table 1.1.

A	The beta haemoglobin gene is used as a positive control.
B	Viral RNA is converted into DNA.
C	The presence of both viral DNA and beta haemoglobin DNA indicates a positive test result.
D	HIV RNA is extracted from the person's blood.
E	DNA is amplified in a PCR machine.

Table 1.1

(i) Place the stages **B** to **E in the correct order** to describe the PCR test for HIV.

_____ _____ **A** ..... _____ _____

[2]

(ii) State **one** other test for HIV that could be performed on a sample of blood.

---

[1]

8. This question is based on the case study **'VACCINATING THE YOUNG' (Case Study 2).**

the NHS now recommends that pregnant women should be given vaccinations against whooping cough.

(i) Explain what is meant by the term *vaccine.*

---

[1]

(ii) When a pregnant woman is vaccinated against whooping cough, both she and her baby gain immunity.

Choose **two** words from the list below to describe the type of immunity gained by the mother, and **two** words to describe the immunity gained by the baby.

NATURAL ARTIFICIAL ACTIVE PASSIVE

Immunity gained by mother _____ and _____

Immunity gained by baby _____ and _____

[1]

(iii) The programme of vaccination used in the United Kingdom (UK) requires booster vaccinations to be given against some diseases, including whooping cough.

Explain why booster vaccinations are necessary.

---

[2]

9(a). The human papillomavirus (HPV) can infect the skin and mucous membranes of the body.

Most cases of HPV infection are eradicated naturally by the immune system.

(i) Statements **A** to **F** below summarise, in random order, the stages of an immune response to the virus.

A	T helper cells are activated and divide by mitosis.
B	B cells are activated, divide by mitosis and then differentiate.
C	Viral antigens are presented.
D	T helper cells release cytokines.
E	Plasma cells synthesise and release antigen-specific antibodies.
F	The virus is engulfed and digested.

Place the letters **A** to **F** representing the statements into the correct order in the boxes below. Statement **D** has been done for you.

[ ] [ ] [ ] [D] [ ] [ ]

[2]

(ii) Describe the role of T killer cells in the immune response to HPV.

---

[1]

(b). Sometimes HPV cannot be eradicated naturally by the immune system. Persistent HPV infection is the main cause of cervical cancer.

A vaccine against the **HPV-16** and **HPV-18** strains is offered to females aged 12 to 14 years.

Scientists wanted to determine whether the vaccine should be given over two or three doses.

They compared the effectiveness of two-dose and three-dose regimes by measuring antibody levels in the blood one month and three years after completion.

The results are summarised in Table 34 below.

Data group	Number of subjects	HPV-16 antibody level ($mMU\,dm^{-3}$)		HPV-18 antibody level ($mMU\,dm^{-3}$)	
		Median	Range	Median	Range
Two-dose regime after one month	102	830	761–882	812	704–866
Two-dose regime after three years		739	729–755	214	101–483
Three-dose regime after one month	116	829	781–893	820	794–860
Three-dose regime after three years		731	718–754	747	709–773

Table 34

(i) Using the information in Table 34, evaluate the effectiveness of different vaccination regimes.

[4]

(ii) Antibody levels were also measured two weeks after the first dose of vaccine. They were significantly lower than those measured after the second and third doses of vaccine.
Explain why.

---

[3]

10. Allergens, such as pollen, are non-pathogenic but can trigger an immune response. This is known as an allergic reaction.

Complete the passage below about an allergic reaction using the most appropriate words or phrases.

Exposure to an allergen triggers the production of IgE antibodies which bind to ..... cells. The allergen molecules then bind to the variable region of the IgE antibodies causing a chemical called ..... to be released from the cells by ..... . This chemical increases the permeability of .... resulting in the formation of excess tissue fluid that leads to swelling and irritation associated with an inflammatory response. **[4]**

11(a). The Mantoux test is used to check if a person is immune to tuberculosis (TB) to decide whether they need a BCG vaccination.

A red inflamed lump (induration) may appear three days after the injection of tuberculin.

A person is considered to be immune to TB if they develop an induration that has a diameter of at least 10 mm.

For an induration of 10 mm the percentage error is 10%.

(i) Explain how this percentage error could lead to incorrect decisions about whether a BCG vaccination is needed.

____

____

____

____

____ [2]

(ii) A health professional measures the diameter of the induration using a ruler marked in millimetres.

Suggest one way this method for measuring indurations could be improved. Explain your answer.

____

____

____

____ [2]

(b). The Mantoux test requires:

- a solution of tuberculin kept away from the light between 2 °C and 8 °C
- a sterile needle and a sterile syringe.

An alternative to the Mantoux test is a more accurate antibody test called ELISA which requires:

- a fresh blood sample
- full laboratory facilities.

The Mantoux test was used on a sample of 89 people and was followed up with an ELISA.
The results are shown in Table 4.1

	Number of people		
	ELISA positive	ELISA negative	Total
Mantoux positive	22	6	28
Mantoux negative	18	43	61
Total	40	49	89

Table 4.1

* Evaluate the use of the Mantoux test and ELISA for testing whether people are immune to TB.

In your answer you should refer to the data in Table 4.1.

---

[6]

12(a) Following the injection of a vaccine the antibody concentration in the blood changes.

.

Fig. 4 shows the concentration of antibody in the blood of an individual following a BCG vaccination for tuberculosis (TB).

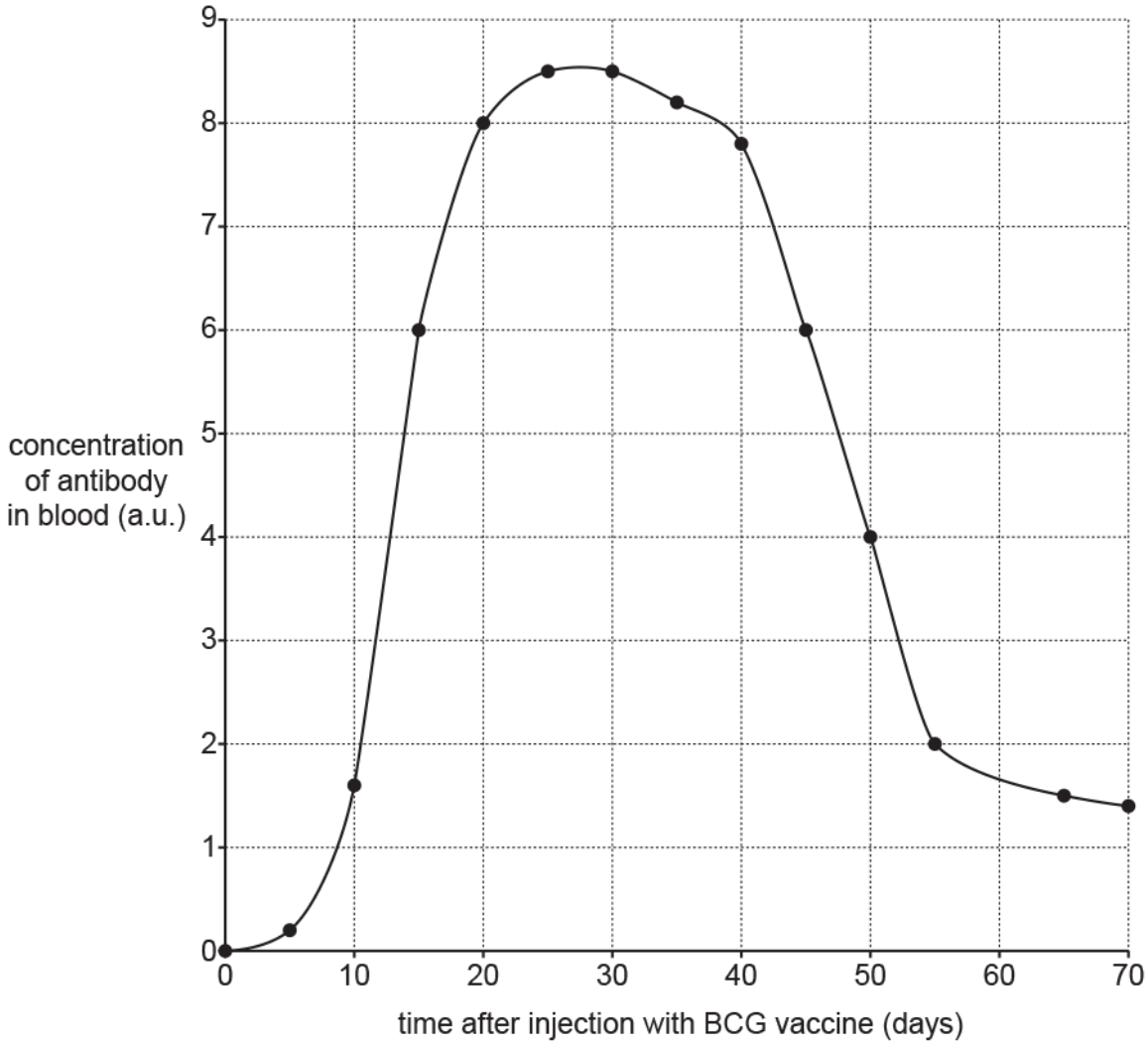


Fig. 4

Describe **and** explain the pattern in the data shown in Fig. 4.

---

[4]

(b). The BCG vaccination can be given to babies and young children considered to be at high risk of contracting TB.

- In 2004, approximately 95 000 babies born in the UK were considered at high risk of contracting TB.
- Only 84 300 of these babies under one year old received the BCG vaccine.
- The BCG vaccine is estimated to be around 74% effective against TB when administered before a baby is one year old.

Using this information, calculate the percentage of babies who would still have been at high risk of contracting TB.

Give your answer to **two** significant figures.

---

[2]

(c). Complete the table below by indicating which of the statements about different types of immunity are true (T) or false (F).

Statement	True (T) or False (F)
An injection of antibodies against the rabies virus will provide artificial active immunity.	
A person recovering from an infection of measles will have natural active immunity to the measles virus.	
A breast-fed baby receiving maternal antibodies will have natural passive immunity.	

[2]

(d). * When certain types of pathogen enter the body they trigger a specific immune response.

Compare the roles of B and T lymphocytes in the specific immune response.

[6]

END OF QUESTION PAPER

Question			Answer/Indicative content	Marks	Guidance
1		i	tuberculin is injected under the skin (1) raised hard area after 48–72 hours (1)	2	ALLOW antigen under skin
		ii	*Agglutinins* *idea of* the antigen binding site / variable region binding to the antigens and clumping the pathogens together (1) *Opsonins* *idea of* the constant region of the antibody allows phagocytic cells to recognise and engulf (1)	2	
			Total	4	
2			Any 1 from: acts as antigen (1) destroyed by cell's immune system (1)	1	
			Total	1	
3			*Error*: cytokinesis *Replacement*: cytokines; *Error*: exocytosis *Replacement*: endocytosis; *Error*: ribosomes *Replacement*: lysosomes;	3	Examiner's Comments It was pleasing to see a good number of correct responses. Monocytes replaced with macrophages was the most commonly seen response that could not be credited.
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
4	a	i	*opsonin* protein / antibody, that enhances phagocytosis by marking antigens / AW ✓ *phagocytosis* (the process by which) cell / phagocyte, engulfs bacteria / pathogens / cell debris ✓	2	CREDIT other named cells e.g. macrophage IGNORE references to engulfing antigens IGNORE digests DO NOT CREDIT lymphocyte for a phagocyte Examiner's Comments This question addressed both AO1 and AO2. The candidates' knowledge of the concepts surrounding antibodies and protein synthesis were being examined in the novel context of the disease, Listeriosis. Required candidates to provide meanings for two of the terms from the specification and whilst a good number of candidates could explain the meaning of *phagocytosis*, the term *opsonin* proved more challenging. Alternative wording was used to credit good responses, but in cases where the full meaning of the term was not provided, marks were not awarded. For candidates who spotted the trigger.

Question			Answer/Indicative content	Marks	Guidance
		ii	*in mammalian cells* *idea that* the protein is synthesised on, rough endoplasmic reticulum / rER OR protein synthesis on, larger / 80S, ribosomes ✓ *idea that* the protein is, packaged / modified, by Golgi (apparatus) ✓ *idea that* the protein is packaged into vesicles which fuse with cell surface membrane ✓	2 max	CREDIT ORA throughout for bacterial cells CREDIT exocytosis occurs Examiner's Comments This question addressed both AO1 and AO2. The candidates' knowledge of the concepts surrounding antibodies and protein synthesis were being examined in the novel context of the disease, Listeriosis. Production of proteins in mammalian cells, this was a fairly straightforward question and there were some good responses demonstrating clear understanding of how proteins are produced and transported within the mammalian cell as opposed to a bacterial (prokaryotic) cell. However, there were a few 'no responses' seen for this part of the question and it is possible that some candidates failed to take on board the context or did not understand that protein synthesis would be different in bacterial cells as they did not have organelles.

Question			Answer/Indicative content	Marks	Guidance
	b		flow cytometry ✓ *idea that* bacteria / *L. monocytogenes*, are tagged by antibodies labelled with fluorescent markers ✓ *idea of* antibodies being immobilised ✓ antibodies may, bind / attach to, (test) antigen / protein / p60 ✓ *idea that* antibodies may be linked to enzymes producing colour reaction ✓	3 max	ACCEPT *idea of* binding leading to production of colour ACCEPT description of ELISA Examiner's Comments This question addressed both AO1 and AO2. The candidates' knowledge of the concepts surrounding antibodies and protein synthesis were being examined in the novel context of the disease, Listeriosis. The diagram of the examiners were pleased to see a number of candidates clearly referring to ELISA tests in their responses and whilst not a learning outcome on the specification, descriptions of such techniques were credited as examples of extended reading on this topic. Reference to flow cytometry was rarely seen, but candidates were able to gain marks in other ways by outlining detail such as antibodies binding to p60 or the bacterial antigens.

Question			Answer/Indicative content	Marks	Guidance
	c		*X* variable region **AND** where antibody binds to specific antigen ✓ *Y* constant region **AND** allows attachment to phagocytes ✓ *Z* hinge region **AND** allows the antibody to flex **OR** to attach to more than one antigen ✓	3	**ACCEPT** antigen-binding site for variable region **ACCEPT** complementary as AW for specific **ACCEPT** macrophage for phagocyte **Examiner's Comments** This question addressed both **AO1** and **AO2**. The candidates' knowledge of the concepts surrounding antibodies and protein synthesis were being examined in the novel context of the disease, Listeriosis. The diagram of the antibody would not have been familiar to candidates but the question was straightforward in asking candidates to recall three labelled parts of the antibody and describe their function. Whilst many candidates could identify **X**, **Y** and **Z**, few were able to consolidate their responses by providing the function for each which was required to gain full credit. Candidates did not receive credit for stating that the hinge region (Z) *'allowed the antibody to move'* unless they had clarified that this would then enable it to attach to more than one antigen. The preferred wording here was 'flex' rather than 'move'.
			Total	**10**	

Question			Answer/Indicative content	Marks	Guidance
5			(tuberculin) antigen is recognised by the immune system / named immune cell ✓ histamine released ✓ (histamine) causes capillaries to become leaky / AW ✓ (histamine) causes the formation of the oedema / swelling ✓ inflammatory response ✓	3 Max	e.g. causes more tissue fluid to form Examiner's Comments Many candidates correctly stated swelling and/or inflammation for Q4(c) with the more capable candidates describing an immune response to the presence of an antigen, although quite a few candidates lost this mark for not referring to antigens. Histamine was often stated but the consequences rarely described.
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
6			Mantoux test; tuberculin **OR** TB antigen; injected (under skin) / AW; wait 48-72 hours; *Idea of* measuring (extent of) inflammation (to determine whether a person has TB) ;	3	**IGNORE** Heaf Test **ACCEPT** sputum test **IGNORE** X-rays **ACCEPT** a figure within this range or 2–3 days / 2 days / 3 days **ACCEPT** measuring size of any raised hardened area / swelling **Examiner's Comments** This question was based on the pre-release material, and tested a range of abilities. Candidates achieved higher marks if they had thoroughly researched the material provided. This question assessed **AO1**, and **AO2** skills. Most students correctly identified the name of the Mantoux test and knew that material was injected under the skin. Some candidates failed to specify that it was TB antigens or tuberculin which were injected, rather than just the bacteria. Most knew the result of the test but did not specify the correct time scale. Few candidates identified that it was the size / measurement of the swelling that identified a positive result. X-rays and blood tests were incorrectly identified as the test.
			Total	**3**	

Question			Answer/Indicative content	Marks	Guidance
7		i	D first and B second; C last;	2	Examiner's Comments Most candidates were able to correctly sequence the stages.
		ii	(HIV) antibody test; (HIV) antigen test;	1 max	ACCEPT ELISA ACCEPT correct description (e.g. use antibodies which will attach to antigens from the virus). Examiner's Comments Most candidates could correctly name another test for HIV. Some imprecise answers such as 'blood test' failed to gain credit.
			Total	3	

Question			Answer/Indicative content	Marks	Guidance
8		i	*idea of* a preparation containing antigens, which, triggers / AW, an immune response / AW;	1	LOOK FOR idea of a weakened or dead microorganism OR fragments of a microorganism DO NOT CREDIT 'disease' for 'microorganism' CREDIT a description of the immune response e.g. producing memory cells Examiner's Comments This question was based on the pre-release material, and tested a range of abilities. Candidates achieved higher marks if they had thoroughly researched the material provided. This question assessed A01, AO2 and AO3 skills. This was usually a well learned definition. Weaker candidates made reference to vaccines containing a weakened form of the disease rather than antigens or the pathogen, or failed to include that it provoked an immune response.
		ii	(mother =) artificial active **and** (baby =) natural passive;	1	Examiner's Comments Several candidates failed to correctly describe the type of immunity gained by vaccination.
		iii	increases, (number of) memory cells; *idea of* memory cell numbers fall over time; faster (immune) response OR ref to <u>secondary</u> (immune) response;	2 max	ACCEPT maintains memory cell numbers ACCEPT more antibody production Examiner's Comments Many candidates were able to identify the requirement for more memory cells, although few picked up on the death or decrease of memory cells over time. Weaker candidates discussed viral mutations as the reason for the requirement for booster vaccinations.

Question			Answer/Indicative content	Marks	Guidance
			Total	4	

Question			Answer/Indicative content	Marks	Guidance
9	a	i	F C A **D** B E ✓✓	2	2 correct = 1 mark Examiner's Comments (a)(i) tended to be either completely correct or wrong, very few candidates achieving partially correct responses.
		ii	kill / destroy, infected (host) cells ✓	1	Examiner's Comments (a)(ii) was not answered well with many candidates thinking that T killer cells killed the virus rather than the virus infected host cells. References to the cell membrane and various other cellular features indicated that candidates had a poor understanding of the nature of viruses.
	b	i	3 FROM *Idea that*: for HPV 16, no significant difference between the 2 dose and the 3 dose regime ✓ for HPV18, two-dose less effective than three-dose ✓ for both HPV16 and HPV18, both regimes produce similar antibody levels at 1 month / 3 years (3 dose) – equally effective ✓ comparison of median or range values in support of one of the above statements ✓ 1 FROM EITHER: top of range for HPV18 antibody levels at 3 years in two- dose schedule does not overlap with ranges in other datasets ✓ OR very large range for HPV18 antibody levels at 3 years in two-dose schedule ✓	4	Examiner's Comments (b)(i) was a demanding question with many candidates not understanding that each dosage regime was one experiment and that the number of antibodies was measured after one month and then after 3 years. The question asked candidates to compare the 2-dose regime with the 3-dose regime for both viral strains. It was common for candidates to focus on the differences in the data instead of explaining how similar most of the data was. Many candidates highlighted tiny differences in median antibody levels despite the extremely large and overlapping ranges. The only candidates to gain full marks were those who appreciated that the 2-dose regime after 3 years was the only data set that had a significantly different median antibody level to all other data because the range did not overlap with any other.

Question			Answer/Indicative content	Marks	Guidance
		ii	**first exposure** no <u>memory</u> B cells prior to first dose ✓ *idea that*: it takes time for clonal selection / clonal expansion / small number of plasma cells to produce antibodies ✓ **second / third exposure** memory cells stimulated to divide rapidly / clonal selection faster / clonal expansion faster ✓ memory cells <u>differentiate</u> into (many) <u>plasma</u> cells ✓ <u>plasma</u> cells produce antibodies faster and in greater numbers ✓	max 3	ALLOW small number of B cells produce antibodies **Examiner's Comments** **(b)(ii)** was a stretch and challenge question and the marks reflected this. Many candidates were clearly familiar with the primary and secondary immune response but relatively few could explain this in good biological detail. Few candidates mentioned the lack of memory cells prior to the first dose or the idea that clonal selection / expansion took time. Similarly, after the second exposure many candidates failed to mention memory cells differentiating and the subsequent plasma cells producing antibodies. Overall, answers were too generalised to gain marks.
			Total	**10**	
10			mast (cells) ✓ histamine ✓ exocytosis ✓ capillary (walls) ✓	4	IGNORE blood vessels <u>Examiner's Comments</u> This gap-fill style question was generally well answered with a spread of marks across the ability range. Many candidates correctly identified the chemical as *histamine* and that it would increase the permeability of *capillary walls*.
			Total	**4**	

Question			Answer/Indicative content	Marks	Guidance
11	a	i	could lead to, false positives / false negatives ✓ if false negative (AW) / has immunity, people receive vaccination when it is not required OR if false positive (AW) / has no immunity, may lead to people not receiving vaccination when it is required ✓ correct use of data to demonstrate percentage error ✓	2 max	IGNORE any reference to vaccination rate or cost of vaccination *e.g. 9mm induration is measured (incorrectly) as 9.9mm → recorded as 10mm → leading to false positive result* *e.g. 10mm induration is measured (incorrectly) as 9.1mm → recorded as 9mm → leading to false negative result* Examiner's Comments This question expected candidates to refer to false positives and/or false negatives. Able candidates used data to support their answer and went on to explain the impact of this error in terms of vaccinating people who were already immune (in the case of a false negative) and vice versa. Other candidates gave vague answers stating answers such as "some people may be vaccinated when they don't need it which is a waste of money".

Question			Answer/Indicative content	Marks	Guidance

		ii	suitable suggestion for improved measuring method ✓
			
			valid / appropriate reasoned argument ✓
				2	IGNORE references to 'reduce percentage error'
					
					e.g.
					
					• callipers
					  ◦ give greater degree of precision
					• use scaled photograph of induration
					  ◦ give greater degree of precision
					• cut-out stencil/ overlay / AW, used as a standard placed on induration
					  ◦ more objective
					• take multiple readings (minimum of 3)
					  ◦ calculate mean value
					
					<u>Examiner's Comments</u>
					
					Candidates who did not perform well in this question focussed on the use of the ruler and suggested more 'accurate' rulers which was not accepted. Candidates who had used or observed the use of (vernier) callipers in their practical skills were able to access this question. Some candidates suggested the use of a photograph but without the use of a scale on the photograph this would not in itself result in an improvement,

Question			Answer/Indicative content	Marks	Guidance
	b		*Summary of instructions to markers:* *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, **Level 1**, **Level 2** or **Level 3**, best describes the overall quality of the answer. Then, award the higher or lower mark within the level, according to the Communication Statement (shown in italics): ◦ award the higher mark where the Communication Statement has been met. ◦ award the lower mark where aspects of the Communication Statement have been missed. • The science content determines the level. • The Communication Statement determines the mark within a level.		
			Level 3 (5–6 marks) Advantages **and** disadvantages of **both** tests discussed. Use of data from Table 4.1 to support a conclusion. *There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3–4 marks)** Advantages and/or disadvantages of both tests mentioned. A relevant reference to Table 4.1 is made. *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.*	6	Indicative scientific points could include: *Advantages of Mantoux test:* • results easy to measure • portable *Disadvantages of Mantoux test:* • requires sterile equipment • requires correct storage of tuberculin • subjectivity involved in measuring induration • gives, significant / AW, number of false results • requires longer period before test results are obtained

Question	Answer/Indicative content	Marks	Guidance
	Level 1 (1–2 marks) Advantages and/or disadvantages of at least one test mentioned. No relevant, correct reference to Table 4.1. *There is an attempt at a logical structure with a line of reasoning The information is in the most part relevant.* 0 marks No response or no response worthy of credit.		*Advantages of ELISA test:* • enables measurement of antibody concentration (in response to administered antigen) • results are objective / more accurate • quicker test *Disadvantages of ELISA test:* • requires (more) specialist training • more expensive • not portable • more specialist equipment required Use of Table 4.1 to support conclusion • 65/ 89 samples give the same result with both tests • 73% (65/89 × 100) of the results are the same (in agreement) in both tests • 24 results are false results • 27% (24/89 × 100) are false results • ELISA have 45% testing positive (40/89) • ELISA have 55% testing negative (49/89) Examiner's Comments The command word in this question is 'evaluate' and to that end candidates were expected to give advantages and disadvantages of both the Mantoux test and the ELISA test. Candidates should be encouraged to give a balanced discussion. Candidates who did not perform well on this question tended to focus on either just advantages or just disadvantages or focus on one type of test. Also in this question candidates were instructed to refer to data in table 4.1. This was not done by a many candidates.

Question			Answer/Indicative content	Marks	Guidance
					Exemplar 5 From the table, it appears that the ELISA test identifies 40 positive results, which is ~~more~~ over 25% more than the Mantaux test. This would suggest ~~in~~ that it is better at giving an accurate, definite result, than the Mantaux test which has a higher number of negatives (61) than ELISA (49), which could perhaps be due to the uncertainty of the health professional when measuring the induration, however to be on the safe side they have diagnosed them as negative for immunity. ~~In~~ ELISA is useful because it could prevent people who may already be immune from receiving unnecessary vaccines, which would be economically beneficial to the NHS. However, [6] ELISA requires fresh blood so must be carried out immediately, and the full lab facilities suggest it is more complicated and expensive than the Mantoux test. This wouldn't be ideal in developing countries where these facilities and funding aren't available. In these circumstances, Mantoux would be more useful. Mantoux is quicker and cheaper, however there could be a risk of catching TB from the tuberculin if the person isn't already immune. Furthermore, the tuberculin requires ~~a~~ good storage, which could be the fridge, although this may not be possible world-wide.
			Total	10	

<table>
<tr><th colspan="3">Question</th><th>Answer/Indicative content</th><th>Marks</th><th>Guidance</th></tr>
<tr><td>12</td><td>a</td><td></td><td>description
1. (small) increase in antibody concentration from ✓
2. rapid increase in antibody concentration between days 5 and 25 ✓
3. antibody concentration peaks at day 25 ✓
4. antibody concentration decreases from day 25 ✓
5. antibody concentration remains higher than before the BCG vaccine ✓
explanation
6. idea that time needed for , antigen / vaccine , to trigger immune response ✓
7. idea that antibody production rises due to differentiation of (B) lymphocytes to plasma cells ✓
8. idea that production and break down of antibody are balanced ✓
9. idea that fewer antibodies produced and more broken down ✓</td><td>Max 4</td><td>ALLOW 3 max from description
ALLOW 3 max from explanation

ALLOW any stated day between 5 to 10

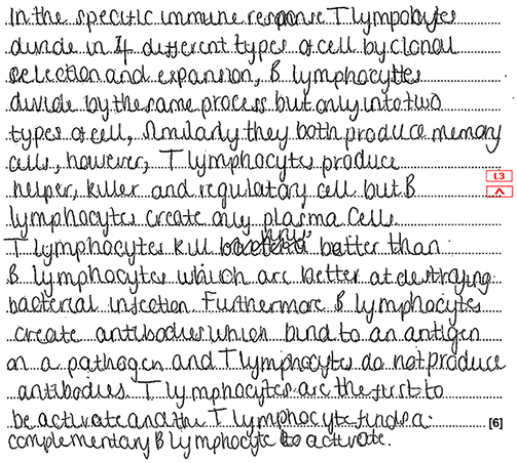
ALLOW any stated days between 5 to 10 and 25 to 30

ALLOW antibody concentration peaks between days 25 and 30

ALLOW any stated day between 25 to 30

<u>Examiner's Comments</u>

On the whole, candidates were able to describe the pattern in the graph but usually found it more difficult to explain the pattern. This was the case even with higher ability candidates that seemed to know the topic. Candidates need more practice linking their scientific knowledge to patterns and trends obtained from unfamiliar data.</td></tr>
<tr><td></td><td>b</td><td></td><td>34% ✓✓</td><td>Max 2</td><td>ALLOW one mark for (84,300/95,000)</td></tr>
<tr><td></td><td>c</td><td></td><td><table><tr><th>Statement</th><th>True (T) or False (F)</th></tr><tr><td>An injection of antibodies against the rabies virus will provide artificial active immunity.</td><td></td></tr><tr><td>A person recovering from an infection of measles will have natural active immunity to the measles virus.</td><td></td></tr><tr><td>A breast- fed baby receiving maternal antibodies will have natural passive immunity.</td><td></td></tr></table>✓ ✓</td><td>2</td><td>Three correct = 2 marks
Two correct = 1 mark
One correct = 0 marks</td></tr>
</table>

Question	Answer/Indicative content	Marks	Guidance
d	*Summary of instructions to markers:* *Read through the whole answer. (Be prepared to recognise and credit unexpected approaches where they show relevance.)* *Using a 'best-fit' approach based on the science content of the answer, first decide which of the level descriptors, **Level 1**, **Level 2** or **Level 3**, best describes the overall quality of the answer.* *Then, award the higher or lower mark within the level, according to the **Communication Statement** (shown in italics):* ◦ *award the higher mark where the Communication Statement has been met.* ◦ *award the lower mark where aspects of the Communication Statement have been missed.* • ***The science content determines the level.*** • ***The Communication Statement determines the mark within a level.*** **Level 3 (5–6 marks)** Provides a comprehensive **comparison** of the roles of both B and T-lymphocytes including similarities **and** differences *There is a well-developed line of reasoning which is clear and logically structured and uses scientific terminology at an appropriate level. All the information presented is relevant and forms a continuous narrative.* **Level 2 (3–4 marks)** Provides a description of the roles of **both** B and T-lymphocytes including similarities **OR** differences *There is a line of reasoning presented with some structure and use of appropriate scientific language. The information presented is mostly relevant.* **Level 1 (1–2 marks)** Provides a brief description of the role of either B OR T-	6	scientific points may include ***B-lymphocyte*** Processed in bone marrow Specific antibody production Differentiation into plasma cells ***T lymphocyte*** Processed in thymus T-helpers Use of cytokines Stimulation of B lymphocytes T-killer/cytotoxic T-regulatory/suppressors ***Both (similarities)*** complementary receptors clonal selection clonal expansion proliferation differentiation memory cell specificity <u>Examiner's Comments</u> Most candidates described T and B Lymphocytes well, but didn't 'compare' which was the focus of the question meaning that they were limited to level 2. **Exemplar 2**  In the specific immune response T lymphocytes divide in 4 different types of cell by clonal selection and expansion, B lymphocytes divide by the same process but only into two types of cell, Similarly they both produce memory cells, however, T lymphocytes produce helper, killer and regulatory cell but B lymphocytes create any plasma cells. T lymphocytes kill bacteria better than B lymphocytes which are better at destroying bacterial infection. Furthermore B lymphocytes create antibodies which bind to an antigen on a pathogen and T lymphocytes do not produce antibodies. T lymphocytes are the first to be activate and the T lymphocyte trade a complementary B lymphocyte to activate. [6] This was a good, well balanced answer

Question			Answer/Indicative content	Marks	Guidance
			lymphocytes with limited/no comparison *The information is communicated with only a little structure. Communication is hampered by the inappropriate use of technical terms.* 0 marks No response or no response worthy of credit		that covered both the similarities and differences of B and T lymphocytes. A lot of candidates just listed what they knew about these different types of cells but in this answer the candidate has actually made comparisons between the cells. This is a skill many candidates do not have and should be practised, especially in preparation for this type of level of response question.
			Total	14	