

# A Level AQA Biology

## 8 The immune system – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	Any two pairs from: skin <b>AND</b> acts as a physical barrier / contains sebum;; tears <b>AND</b> contains lysozymes to destroy pathogens;; stomach acid <b>AND</b> destroys pathogens in food;; hairs (in nose and ears) <b>AND</b> traps pathogens and dust;; mucus <b>AND</b> traps pathogens and removes them by movement of cilia;;	One mark for a correctly named feature; one mark for a correct explanation	4 max	AO1 3.2.4
01.2	Any four from: phagocytes recognise foreign antigen (on pathogen) by surface receptors; engulf pathogen by binding to antigen, forming a <u>phagosome</u> ; phagosome fuses with <u>lysosomes</u> ; forms <u>phagolysosome</u> ; hydrolytic enzymes / lysozymes in lysosomes digest / destroy pathogen;		4 max	AO1 3.2.4
01.3	carbohydrases / amylase <b>AND</b> protease; (hydrolyses) carbohydrates into simple sugars / monosaccharides; (hydrolyses) proteins into amino acids;	Do not credit if the enzyme is incorrectly linked to the substrate and/or product Accept named enzyme (e.g., endopeptidase)	3	AO2 3.2.1.1 3.2.1.2 3.3.3
01.4	phagocytes present (parts of) foreign antigen on the cell surface membrane / become <u>antigen-presenting cells</u> ; antigens presented are recognised by receptors on <u>helper T cells</u> ; helper T cells become activated to start the <u>cell-mediated immunity / cellular response</u> ;		3	AO1 3.2.4
02.1	delivery of therapeutic medicines;	Accept accurate example, such as targeted cancer therapy	1	AO1 3.2.4

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02.2	Any four from: apply sample (with protein) to a surface; add antibodies complementary to the protein onto the surface, allowing them to bind to protein; add a second antibody with attached enzyme that binds to the first antibody; add a colourless substrate to the mixture, which breaks down in reaction catalysed by the enzyme to produce a coloured product; the intensity of the colour shown is proportional to the concentration of protein present in the sample;		4 max	AO1 3.2.4
02.3	ALT and AST naturally exist in the body; (diagnosis using monoclonal antibodies) does not test for quantity / ELISA test can give a quantity;		2	AO3 3.2.4
02.4	remove excess molecules / protein / antigen / antibody which may produce a result showing higher than actual levels <b>OR</b> to reduce background signal;		1	AO2 3.2.4
02.5	Any one <u>pair</u> from: many antibiotics work by weakening/damaging/prevent synthesis of the cell walls (of bacteria) <b>AND</b> viruses have a protein coat / do not have a murein cell wall (so are not damaged by these antibiotics);; many antibiotics interrupt replication/reproductive machinery/protein synthesis of target cells <b>AND</b> viruses rely on host cells' replication/reproductive machinery (so reproduction not disrupted by these antibiotics);;		2 max	AO1 3.2.4

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03.1	<p>Any six from:</p> <p><i>For:</i>  saves lives;  prevents devastating effects of getting these diseases (long term health problems);  herd immunity protects the vulnerable of society, e.g., those who can't be vaccinated;  economically important to prevent illness, e.g., people continue to work / pay taxes;  vital to protect health care workers at higher risk of catching disease;</p> <p><i>Against:</i>  small risk of side effects / might not work;  needle phobia for some;  very expensive to develop;  not all diseases have a vaccine, due to no funding;</p>	<p>Accept any reasonable suggestion</p> <p>Full marks only given if points discussing both ethical and safety issues present</p>	6 max	AO3 3.2.4
03.2	<p>active immunity: the body is triggered to produce its own antibodies / have an immune response / exposed to antigens <b>OR</b> conveys long term immunity;  passive immunity: (non-self) antibodies are injected into the bloodstream <b>OR</b> conveys short term immunity;</p>		2	AO1 3.2.4
03.3	<p><i>Non-specific:</i>  destroys / traps all foreign cells / pathogens;  e.g., phagocytosis;</p> <p><i>Specific:</i>  kills particular pathogens by recognising their specific antigens;  e.g., antibodies targeting specific antigens or toxins / AVP;</p>		4	AO1 3.2.4

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03.4	$\frac{50000 - 160000}{160000} \times 100;$ <p>= - 68.8%;</p>	<p>Max 1 marks if answer is not presented to 3 sig. fig.</p> <p>Max 1 mark if minus sign is not included</p>	2	AO2 3.2.4
03.5	<p>Any two from:            due to fewer cases of whooping cough reported/whooping cough not considered a significant risk;            fear / Risk of side effects caused by vaccines;            insufficient vaccines available / too expensive to produce or deliver;</p>	Accept any sensible answer	2 max	AO2 3.2.4
03.6	<p>Yes  <b>AND</b>            Any two from:            (nearly) 81% of the population are vaccinated against whooping cough;            most people are immune against whooping cough / fewer people to spread the bacteria;            established <u>herd immunity</u>;            unvaccinated / Susceptible people less likely to contact infected individuals;</p> <p><b>OR</b></p> <p>No  <b>AND</b>            Any two from:            still have around 20% of the population susceptible to whooping cough;            vaccinated people may not be distributed evenly for herd immunity effect to take place;            unvaccinated / Susceptible people still likely to contact infected individuals;</p>	<p>Simply saying “yes” or “no” does not score any marks</p> <p>Ignore point if no specific reference to whooping cough</p>	2 max	AO3 3.2.4

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04.1	most of the <u>antigens</u> on the <i>Plasmodium</i> parasite are hidden within red blood cells / most <i>Plasmodium</i> individuals are within red blood cells; only some that have not entered the red blood cells are recognised and killed / pathogens within red blood cells cannot be recognised by antibodies;		2	AO2 3.2.4
04.2	Any six from: <u>clonal selection</u> occurs; B cell with complementary antibody recognises / engulfs the pathogen by <u>endocytosis</u> ; B cell digests and presents antigen on cell surface; gets recognised and activated by T helper cells; activated B cells undergo <u>clonal expansion</u> ; by mitosis; B cells produce many antibodies specific to pathogen antigens; antibodies bind to and destroy infected cells / act as agglutinins;		6 max	AO1 3.2.4
04.3	Any two from: quaternary protein; 4 subunits / polypeptides (2 $\alpha$ and 2 $\beta$ )/ has a quaternary structure; each subunit contains an Fe <sup>2+</sup> -containing haem group;		2 max	AO1 3.1.8 3.3.4.1
04.4	shortness of breath / easy to faint / out of breath; less haemoglobin available to transport oxygen;		2	AO2 3.3.4.1
04.5	red blood cells no longer have a biconcave shape, which disrupts pathogen / infection; hinders <i>Plasmodium</i> infecting red blood cells; so more <i>Plasmodium</i> individuals (in bloodstream and to be) destroyed by (named) white blood cells;		2	AO2 3.3.4.1

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04.6	HIV; replicates in and (over time) destroys T helper cells / prevents interleukins being released; humoral / active immune response not triggered / antibodies not made under infection of other pathogens;	One mark for pathogen Two marks for description	3	AO1 3.2.4
05.1	Any three from: concentration of antibodies increases from 0 a.u. at day 4; peaks at 25 a.u. on day 13; then decreases at a rate slower than rate of increase; concentration of antibodies returns to zero at day 27;		3 max	AO2 3.2.4
05.2	higher peak <b>AND</b> steeper increase than the first infection; antibodies appear between days 30 and 33 <b>AND</b> concentration at day 60 should be higher than initial peak on day 13;		2	AO2 3.2.4
05.3	disulphide bonds;		1	AO2 3.2.4
05.4	variable region; (specific shape to) <u>bind</u> to <u>specific</u> antigens / specific antigen binding site / form antibody-antigen complex;		2	AO1 AO2 3.2.4
05.5	Any two from: region <b>B</b> (constant region) forms <u>peptide</u> bonds with region <b>A</b> (variable region); as they are on the same (light / heavy) chain; part of its <u>primary</u> structure; <b>OR</b> both regions are folded into <u>secondary</u> and/or <u>tertiary</u> structures; interact by <u>hydrogen bonds</u> / <u>disulphide bonds</u> / <u>hydrophobic interactions</u> ;		2 max	AO1 AO2 3.1.4.1
06.1	droplet infection / droplets in coughs and sneezes / virus present in coughs and sneezes;		1	AO2 3.2.4

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06.2	Any one <u>pair</u> from: wear face masks <b>AND</b> to stop droplets from sneezing / coughing to spread <b>OR</b> to avoid inhaling droplets from other people;; Wash hands frequently <b>AND</b> to destroy / remove viruses on hands;;  Avoid touching your eyes/ mouth / nose / ears <b>AND</b> to not introduce the virus into body;	Accept any reasonable suggestions, supported with a valid reason  IGNORE face	2 max	AO2 3.2.4
06.3	Any three from: fast production of antigen-presenting cells / memory cells may convey immunity sooner; mRNA cannot integrate into host genome (not permanently changing body cells); does not contain any infectious content of the virus itself (unlike weakened virus vaccines); mRNA section only codes for antigen structure, no risk of recombination producing infectious viral material (unlike inactivated virus vaccines); potentially fewer side effects as only mRNA injected; mRNA strand is broken down once protein is made so not present in body permanently;		3 max	AO3 3.2.4
06.4	respiratory / lung epithelial cells; <b>AND</b> Any two from: excess mucus produced to trap virus; virus infects / destroys <u>ciliated epithelial cells</u> , so unable to remove mucus; mucus and virus stay in respiratory system, causing inflammation of cells in lungs / filling of lungs with fluid;	One mark for cell type, two marks for explanation	3 max	AO1 AO2 3.3.2
06.5	decreased tidal volume <b>OR</b> fluids fill alveoli leading to inefficient gas exchange / lower oxygen levels in blood; so, less oxygen travels to the brain / less ATP made from less aerobic respiration;		2	AO1 AO2 3.3.2

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06.6	<p><i>Healthy:</i> take average tidal volume from at least 3 readings from the graph / <math>0.5 \text{ dm}^3</math> <math>\text{PVR} = 0.5 \times 10 = 5.00 \text{ (dm}^3 \text{ min}^{-1}\text{)}</math>;</p> <p><i>ARDS patient:</i> <math>\text{PVR} = 0.15 \times 21 = 3.15 \text{ (dm}^3 \text{ min}^{-1}\text{)}</math>;</p>	Accept 0.1–0.2 as the tidal volume for ARDS patient	2	AO2 3.3.2																																
07	<p>The importance of cell signalling and communication in living organisms.</p> <table border="1"> <thead> <tr> <th>Specification reference</th> <th>Topic area</th> </tr> </thead> <tbody> <tr><td>3.1.4.2</td><td>Enzyme-catalysed reactions</td></tr> <tr><td>3.1.6</td><td>ATP</td></tr> <tr><td>3.2.2</td><td>Cell division</td></tr> <tr><td>3.2.3</td><td>Transport across membranes</td></tr> <tr><td>3.3.2</td><td>Gas exchange</td></tr> <tr><td>3.2.4</td><td>Immune response</td></tr> <tr><td>3.3.3</td><td>Digestion and absorption</td></tr> <tr><td>3.3.4</td><td>Mass transport</td></tr> <tr><td>3.4.2</td><td>DNA and protein synthesis</td></tr> <tr><td>3.5.1</td><td>Photosynthesis</td></tr> <tr><td>3.5.2</td><td>Respiration</td></tr> <tr><td>3.6.1.1</td><td>Survival and response</td></tr> <tr><td>3.6.1.2</td><td>Receptors</td></tr> <tr><td>3.6.2.1</td><td>Nerve impulses</td></tr> <tr><td>3.6.2.2</td><td>Synaptic transmission</td></tr> </tbody> </table>	Specification reference	Topic area	3.1.4.2	Enzyme-catalysed reactions	3.1.6	ATP	3.2.2	Cell division	3.2.3	Transport across membranes	3.3.2	Gas exchange	3.2.4	Immune response	3.3.3	Digestion and absorption	3.3.4	Mass transport	3.4.2	DNA and protein synthesis	3.5.1	Photosynthesis	3.5.2	Respiration	3.6.1.1	Survival and response	3.6.1.2	Receptors	3.6.2.1	Nerve impulses	3.6.2.2	Synaptic transmission		25	3.1.4.2 3.1.6 3.2.2 3.2.3 3.3.2 3.2.4 3.3.3 3.3.4 3.4.2 3.5.1 3.5.2 3.6.1.1 3.6.1.2 3.6.2.1 3.6.2.2 3.6.3 3.6.4.2 3.6.4.3 3.8.2.3
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	3.6.3	Skeletal muscle		
	3.6.4.2	Control of blood glucose concentration		
	3.6.4.3	Control of blood water potential		
	3.8.2.3	Gene expression and cancer		

### Skills box answers

Question	Answer
1	Pre-vaccine = 1677.34 Post-vaccine = 982.22
2	The post vaccine dataset has the least deviation from the mean (the lowest standard deviation) and therefore is more reliable
3	Outlier = 9.80, this could increase the standard deviation of the sample and reduce the reliability of the results.
4	895.67
5	The pre-vaccine sample's standard deviation has reduced, and the results are now more reliable than the post-vaccine results.