

Unit 3 Biology

Revision Booklet 7

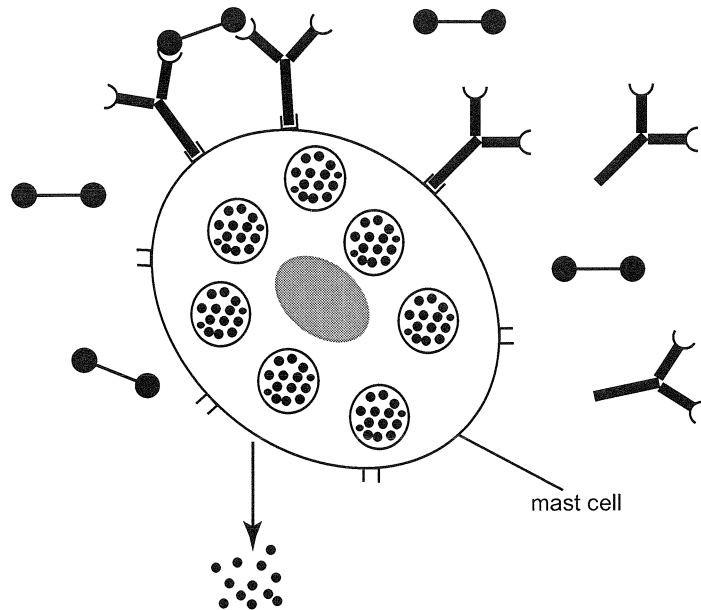
Topics

Immunity

Name:

Question 2 (2012)

Mast cells are found in a number of different tissues and play an important role in allergic reactions. Consider the following diagram.



Label **at least three** appropriate parts of the diagram related to the activation and action of a mast cell.

Referring to the diagram and labels you have entered, outline the order of events that occur during allergic reactions.

4 marks

SECTION B – continued
TURN OVER

Question 4 (2012)

Australia is currently experiencing an epidemic of pertussis. Pertussis is a highly contagious respiratory infection caused by the bacteria *Bordetella pertussis* (whooping cough). Pertussis vaccine is offered as part of an immunisation program for children at two months, four months, six months, four years and in Year 10 of secondary school.

- a. i. Name the cells that are responsible for the production of antibodies.

Two children have been immunised according to the schedule. One is two months old and the other is four months old.

- ii. What difference would there be in the children's levels of antibodies against *Bordetella pertussis*?

1 + 1 = 2 marks

Consider a Year 10 student. Memory cells will have been produced during the periods of immunisation when the student was younger.

- b. What are **two** advantages of having these memory cells when the student receives their immunisation in Year 10?

2 marks

In Victoria in the past two years the number of cases of pertussis has increased dramatically. In 2010 there were over 6500 reported cases of pertussis; 66 per cent of these cases were adults and most of these adults had been immunised in childhood.

- c. i. Outline a likely reason for the high percentage of adults with pertussis in 2010.

- ii. Describe one process that could be introduced by the Department of Health, Victoria, to reduce the number of adults being infected with pertussis.

1 + 1 = 2 marks

The human immune response to antigens of *Bordetella pertussis* can be measured by the level of antibodies in the blood.

- d. Is this test a measure of cell-mediated immunity? Explain your answer.

1 mark

Question 7 (2012)

Yellow fever is caused by a virus transmitted through the bite of a particular species of mosquito.

- a. Would you describe a virus as a cellular or non-cellular pathogen? Justify your answer.

2 marks

- b. An unvaccinated person travelled to an area where yellow fever virus existed and became exposed to the virus. Describe **two** ways in which the first line of defence of their body would protect against an infection by this virus.

2 marks

- c. As a requirement for re-entry, travellers returning to Australia from Africa and South America must have proof of vaccination against yellow fever.

Explain why this precaution is taken and what course of action Australian authorities may take for an unvaccinated person wanting to re-enter Australia.

2 marks

SECTION B – continued
TURN OVER

Question 2 2011

The thymus is an important organ in the immune system. As humans grow older, there is a change in the weight of the thymus and an increase in the proportion of fat it contains.

Examine the following table.

Age	At birth	10 years	20 years	30 years	60 years
Average weight of thymus (gram)	20	35	20	15	5

- a. Explain the likely consequence of this change in thymus weight in an individual.

2 marks

After two days at a school camp, seven-year-old Paul developed large, itchy red patches and blisters on his right arm. Within two days it had spread to many parts of his body. Paul was diagnosed with a sensitivity reaction to a plant called poison ivy.

- b. Describe the sequence of events that would result in the red patches and blisters on Paul.

3 marks

Paul was given skin cream to apply to his itchy red blisters. He was also asked to shampoo his hair, wash his body thoroughly with soap and water and cut his nails short.

- c. Explain why these instructions were given to Paul.

1 mark

Paul was also advised to wear long pants and long-sleeved shirts on any future hikes.

- d. Explain why it is important for Paul to follow these instructions.

2 marks

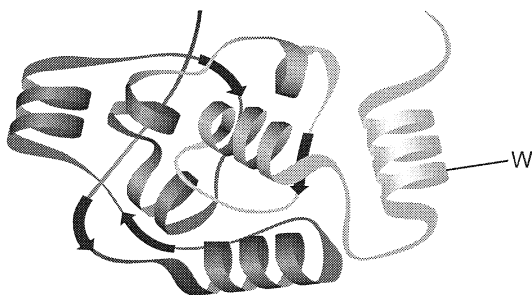
Total 8 marks

Question 4 200

- a. Draw a labelled diagram of the arrangement of the phospholipids in a plasma membrane.

2 marks

The membrane of human plasma cells contains Toll-like receptors (TLR). A portion of one type of TLR is shown below.



- b. What is the name given to the type of secondary protein structure labelled W?

1 mark

Autoimmune diseases such as asthma and eczema are increasing in the Australian population. It is hypothesised that the TLRs in human cell membranes are not being stimulated enough, due to our strict hygiene practices including the overuse of antibacterial hand washes. As a result, in some individuals, the absence of a range of antigens leads to a situation in which TLRs stimulate T cells to attack self cells. This results in an autoimmune disease.

A group of scientists recruited 120 women who already had a child or close family member with asthma or eczema. These women took part in a research experiment as outlined in the following table.

	Group A 60 women	Group B 60 women
Experimental method	<ul style="list-style-type: none"> • Pregnant women given probiotics for 2 months prior to baby's birth. • Baby is given probiotics every day for the first 18 months of life. 	<ul style="list-style-type: none"> • Pregnant women given placebo for 2 months prior to baby's birth. • Baby is given placebo every day for the first 18 months of life.
Results	<ul style="list-style-type: none"> • 25% of the babies developed symptoms of asthma or eczema. 	<ul style="list-style-type: none"> • 90% of the babies developed symptoms of asthma or eczema.

Note: Probiotics are cultures of beneficial bacteria normally found in the human intestine. During pregnancy, the probiotics pass through the umbilical cord from mother to baby.

c. What is meant by a placebo?

1 mark

d. Explain why the babies from Group A were less likely to develop asthma or eczema. Include reference to the immune system in your answer.

2 marks

Mice can also develop autoimmune diseases such as asthma and eczema. Scientists wished to repeat the experiment using mice susceptible to developing asthma and eczema.

e. What are two factors in the experimental design that scientists would have to control?

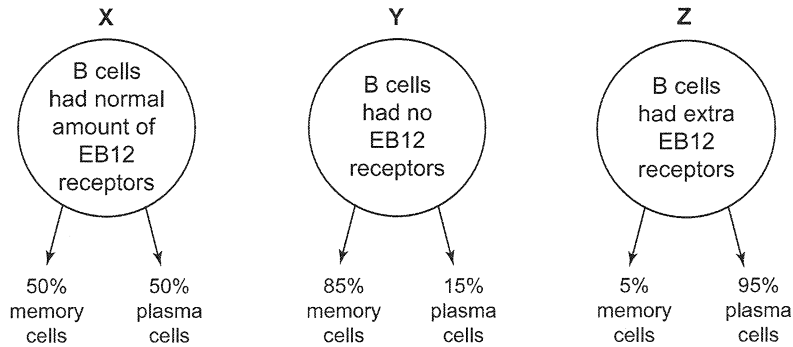
2 marks

Total 8 marks

**SECTION B – continued
TURN OVER**

Question 4 (2010)

EB12 is a receptor on the B cells of mice that helps determine if a cell becomes a plasma or a memory cell. Scientists used three different strains of mice to investigate B cell immunity. None of the strains had been exposed to the influenza virus. The strains were as follows.



The three mice strains were infected with the influenza virus.

- a. Explain which strain, X, Y or Z, would be best at destroying the fast-acting influenza virus.

2 marks

- b. Explain how blocking the action of EB12 receptors could result in the production of a more efficient vaccine.

2 marks

Total 4 marks

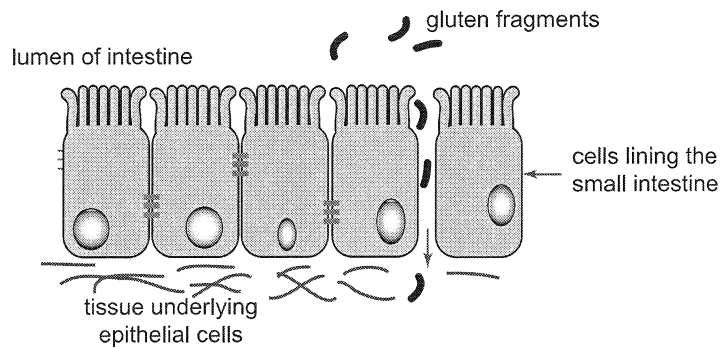
Question 7 (2010)

Coeliac disease in humans is caused when cells of the immune system attack the epithelial cells that line the small intestine.

- a. What is the general name given to this type of disorder?

1 mark

Coeliac sufferers are unable to break down the gluten found in grains such as wheat. One of the features of coeliac disease is 'leaky gut syndrome'. A small gap appears between the epithelial cells that line the small intestine. Gluten fragments enter the gap and accumulate under the epithelial cells. Macrophages are stimulated to remove the fragments.

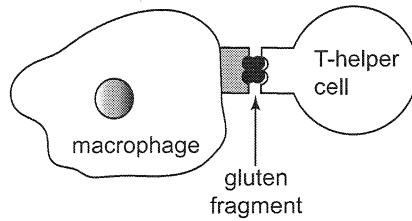


- b. Explain how a macrophage is able to remove and destroy a gluten fragment. You may use a written answer or labelled diagrams or both.

2 marks

Once a macrophage has destroyed a gluten fragment, it displays a piece of the fragment on its membrane using a special major histocompatibility complex (MHC) marker. A T-helper cell then attaches to the MHC marker-antigen complex.

The macrophage T-helper cell complex is shown below.



The macrophage T-helper cell complex stimulates other cells and chemicals to target and damage epithelial cells that line the intestine.

- c. Name one cell or chemical that would be stimulated by the macrophage T-helper cell complex and state its function.

Name _____

Function _____

2 marks

Assume that a drug has been shown to be safe for human use and is about to be trialled. Assume that you suffer from coeliac disease and have been invited to take this drug as part of the trial.

- d. What are two different questions about the drug trial that you would ask your doctor?

Question 1 _____

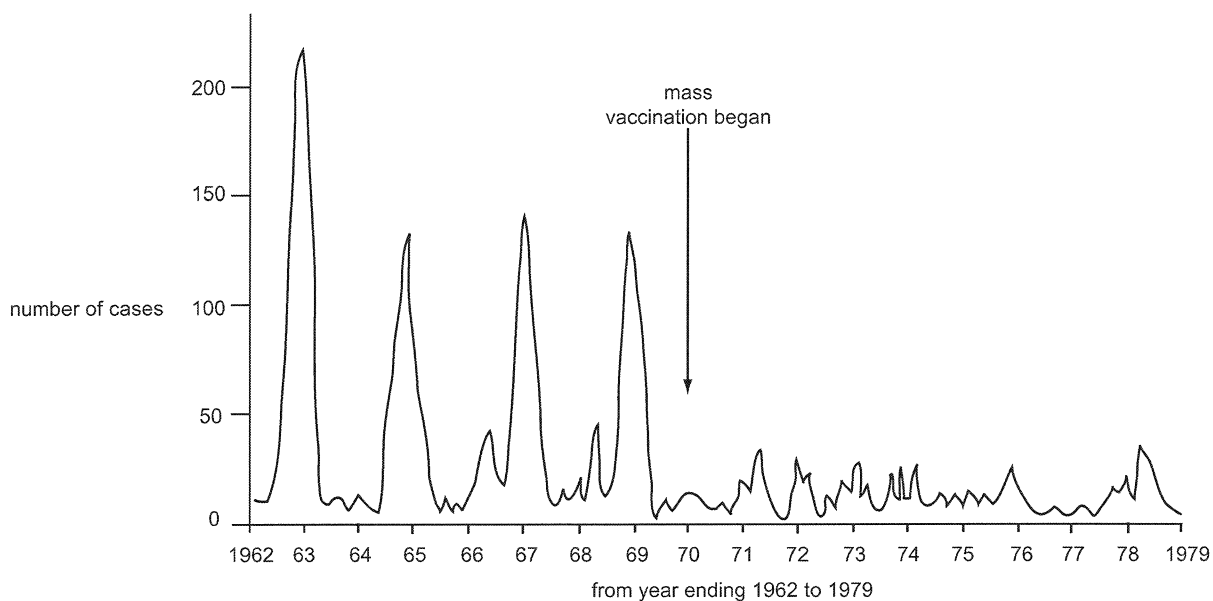
Question 2 _____

2 marks

Total 7 marks

Question 8 (2010)

Measles is a highly contagious, serious disease caused by an RNA virus. There were regular epidemics of the disease until the introduction of mass vaccination. The following graph indicates the incidence of measles in Victoria from 1962 to 1979.



a. What was the time period between successive epidemics?

1 mark

An unaffected person without immunity has a 90 per cent chance of catching the disease if they live in the same house as a person with the disease.

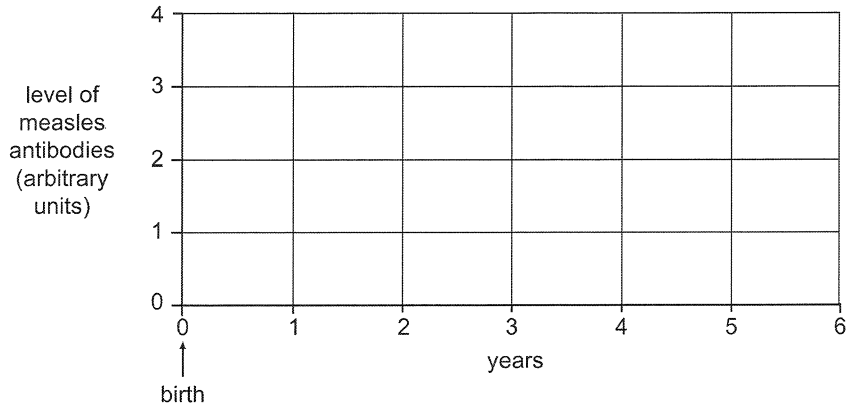
If a child is suspected of having measles, a serum sample is taken and tested for measles-specific IgM and IgG antibodies.

b. What conclusion could be made if high levels of these antibodies were found and what action would be taken?

2 marks

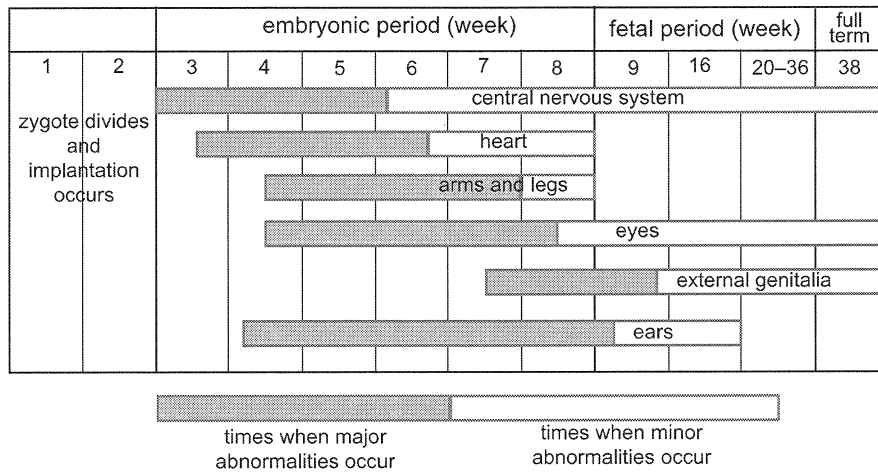
In Australia, vaccination against measles is a two-dose schedule. The first dose is generally given at age 12 months and the second dose at 4 years.

- c. On the grid below, graph the level of measles antibodies you would expect in a vaccinated child. The child's mother is known to have had measles as a child.



2 marks

Rubella is a contagious viral disease. An individual may have the disease for two or more weeks before it is diagnosed. If a pregnant woman is infected with *Rubella*, the developing baby may develop serious defects. The following diagram outlines the development of various organs of a baby in utero.



Each bar shows the time over which a particular organ develops.

Two pregnant women are diagnosed with *Rubella*. Mrs Smith is 6 weeks pregnant and Mrs Jones is 28 weeks pregnant.

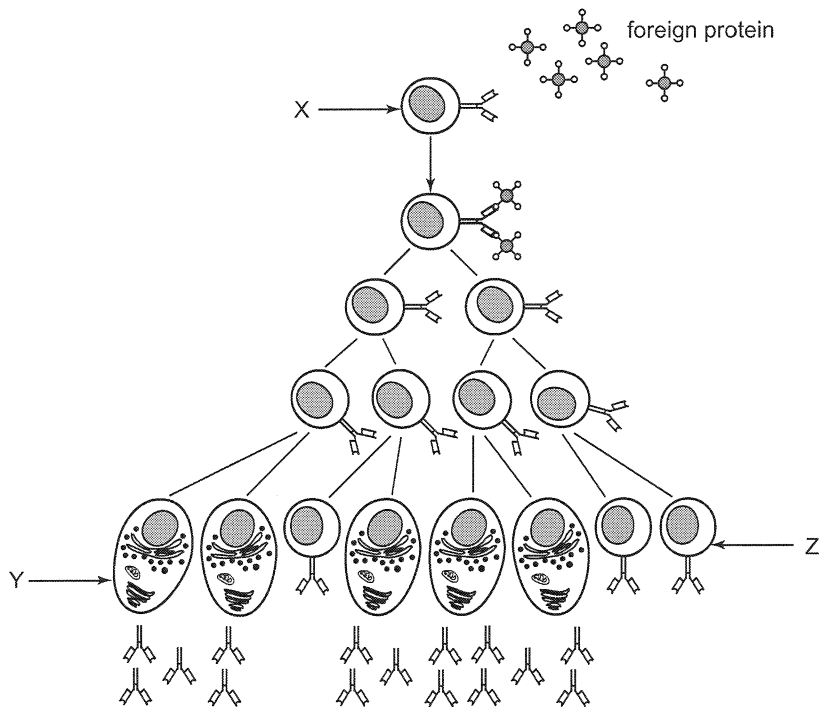
- d. Which embryo or fetus is at greater risk of developing a major defect? Refer to at least two areas of development to support your answer.

2 marks

Total 7 marks

Question 7 2009

In 1960, Australian Sir Frank Macfarlane Burnet was awarded the Nobel Prize for Medicine for correctly predicting how the body's immune system responds to infection. A diagrammatic summary of Burnet's [Clonal Selection] theory is shown below.



a. Name cell X.

1 mark

b. i. Name cell Y.

ii. What is the function of this type of cell?

1 + 1 = 2 marks

c. i. Name cell Z.

ii. What is the function of this type of cell?

1 + 1 = 2 marks

d. Name an autoimmune disease.

1 mark

- e. Outline the events that lead to the development of an autoimmune disease.

2 marks

Total 8 marks

Question 5 2008

Normally in mammals, if tissue from another individual enters the body, the foreign cells are recognised as 'non-self' by the immune system. The tissue is then rejected unless special drugs are used.

- a. i. Which cells of the immune system are initially responsible for recognising **non-self** cells introduced by an organ transplant?

- ii. How do the cells you have named in part i. distinguish between **self** and **non-self** cells?

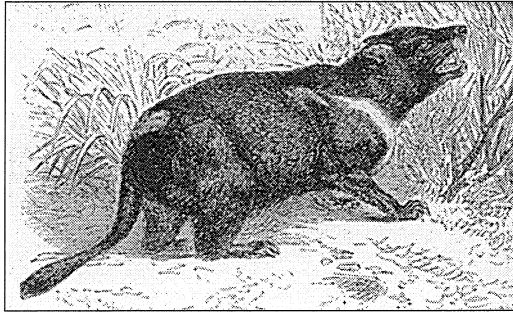
1 + 1 = 2 marks

- b. Describe the process of tissue rejection after recognition of the **non-self** cells has occurred.

2 marks

The drawing below, made in 1886, shows the Tasmanian devil, *Sarcophilus harrasii*.

The Tasmanian devil is the largest surviving carnivorous marsupial in Australia. It is officially in danger of extinction due to the deadly Devil Facial Tumour Disease (DFTD), a type of cancer.



DFTD is an unusual type of cancer because it can be passed from one individual to another when deep wounds occur as they fight over food or as they mate. Tumour cells in the mouth or cheek of an infected animal break off and enter a deep wound on an uninfected animal. The tumour cells multiply in the body of the newly infected devil, eventually forming new tumours that kill the animal.

Recent research has shown that the immune system of an unaffected Tasmanian devil responds in the usual way to tissue from other mammalian species. However, a devil accepts tumour cells from another devil as if they are 'self' cells. The tumour cells are ignored, no immune response develops against them, and so the cancerous cells multiply.

- c. Suggest why DFTD tumour cells are accepted as **self** cells by previously uninfected Tasmanian devils.

1 mark

- d. Would you consider tumour cells which have entered the body of an unaffected devil to be pathogens? Support your answer.

1 mark

Total 6 marks

Question 2 2007

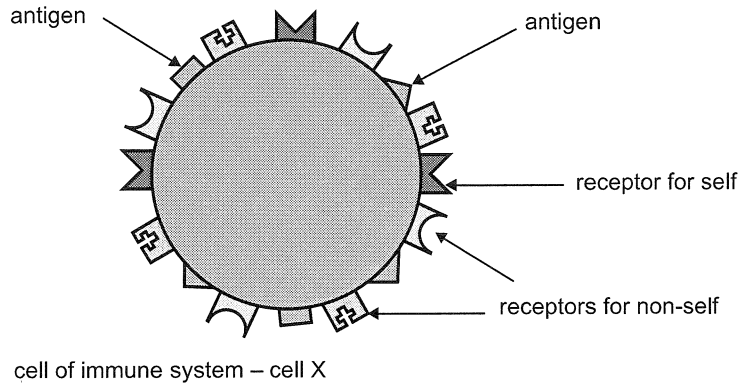
- a. Briefly explain the role that each of the following have in the immune response to infection.
 - i. Phagocytes

- ii. Complement proteins

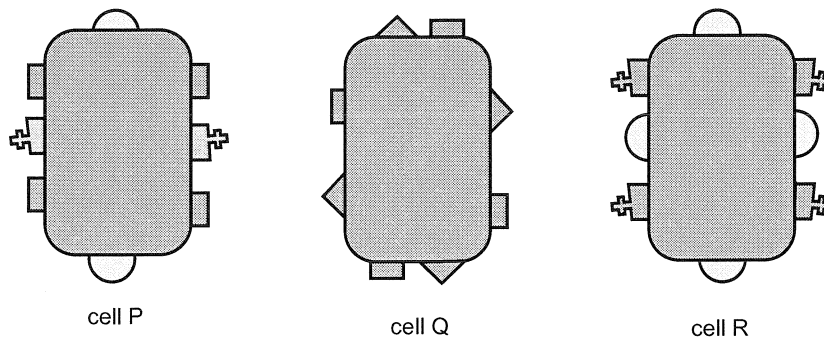
1 + 1 = 2 marks

Immune cells have many different kinds of receptors on their plasma membranes as well as different kinds of self antigens. Some of the receptors are for self antigens and some are for non-self antigens. By examining other cells for the presence of self and non-self antigens, immune cells can determine the kind of threat those other cells might be for the organism. The more non-self antigens an immune cell detects, the greater will be its reaction against a cell it comes into contact with.

Examine the following immune cell. Note the kinds of antigens and receptors it has.



This immune cell X encounters the following three cells.



b. i. Which of these cells, P, Q or R, will cause the greatest response from cell X?

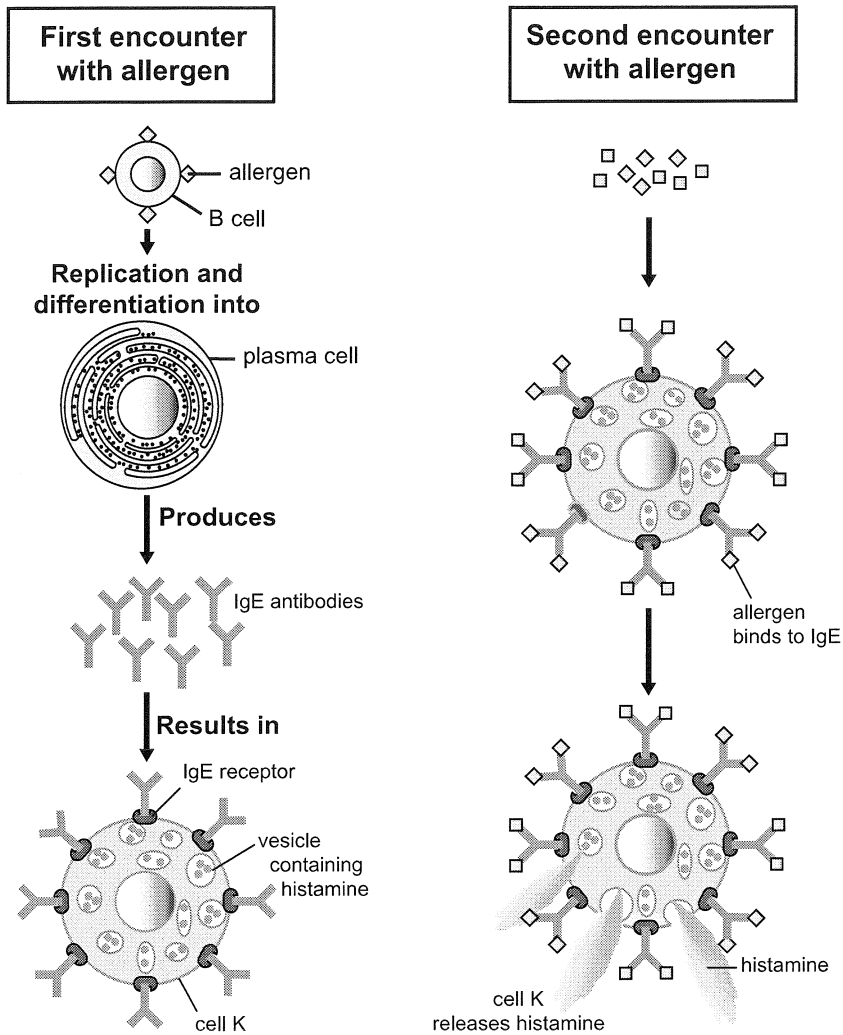
ii. Explain the choice you made in **part b.i.**

1 + 1 = 2 marks

Total 4 marks

Question 5 2007

The diagrams below outline the sequence of events involved in an allergic response.



a. Name one well-recognised allergen.

1 mark

Examine the plasma cell shown in the above diagram.

b. i. Identify the organelle that is abundant in the cytosol of the plasma cell.

ii. Explain the specific role of this organelle in the plasma cell.

1 + 1 = 2 marks

- c. i. Name the type of cell represented by cell K.

Cells of type K can produce localised allergic responses in particular regions of the body.

- ii. Name one such region of the body.

- iii. Describe one effect of the release of histamine by cell K into the surrounding extracellular fluid or bloodstream.

- iv. Name the process by which histamine is released by cell K.

1 + 1 + 1 + 1 = 4 marks

Total 7 marks

Question 7 2006

Plants and animals are both susceptible to infection.

- a. i. Name one feature of plants that inhibits the entry of infective organisms.

- ii. Name one feature of humans that inhibits the entry of infective organisms.

1 + 1 = 2 marks

Assume that infection has occurred in a plant.

- b. Outline one way in which a plant responds to minimise damage to its tissues.

1 mark

Assume that infection has occurred in a human.

- c. Outline two general features of inflammation that minimise the impact of the infection.

Feature 1 _____

Feature 2 _____

2 marks

- d. Explain how cells of the immune system determine self from non-self molecules.

1 mark

- e. What substance does the body normally produce in response to an antigen?

1 mark

Many people have an adverse reaction to a particular kind of food or other material. The material causing the reaction is called an allergen and the reaction is called an allergic response.

- f. Explain the relationship between an allergen, mast cells and histamines.

2 marks

Total 9 marks