PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



EXAM QUESTION PACK

TOPIC 7: MODERN GENETICS

GENE TECHNOLOGY

SCORE	PERCENTAGE
/110	%

STEMUP

These questions belong to Pearson Edexcel, not to us.

The examination questions and mark schemes in this pack were written and published by Pearson Edexcel. They are past assessment materials, reproduced here so that students can revise from them.

What we do not own

STEMUP is not affiliated with Pearson Edexcel and does not own, and makes no claim to own, any of the question or mark scheme material in this pack. Pearson has not endorsed, approved or been involved in the production of it. Pearson, Edexcel and the qualification titles used here belong to their respective owners and appear for identification only.

Where to find the originals

Pearson publishes its past papers and mark schemes free of charge. Always check the current specification at qualifications.pearson.com before you revise, because content and wording can change between series.

If you hold the rights to any material in this pack and would like it amended or removed, contact admin@stemup.co.uk and we will act on it.

Q1.

In July 2014, scientists announced that '*Tpl2*-KO' knockout mice were resistant to inflammation of the spinal cord.

Describe what is meant by '*Tpl2*-KO' knockout mice.

(2)

.....

.....

.....

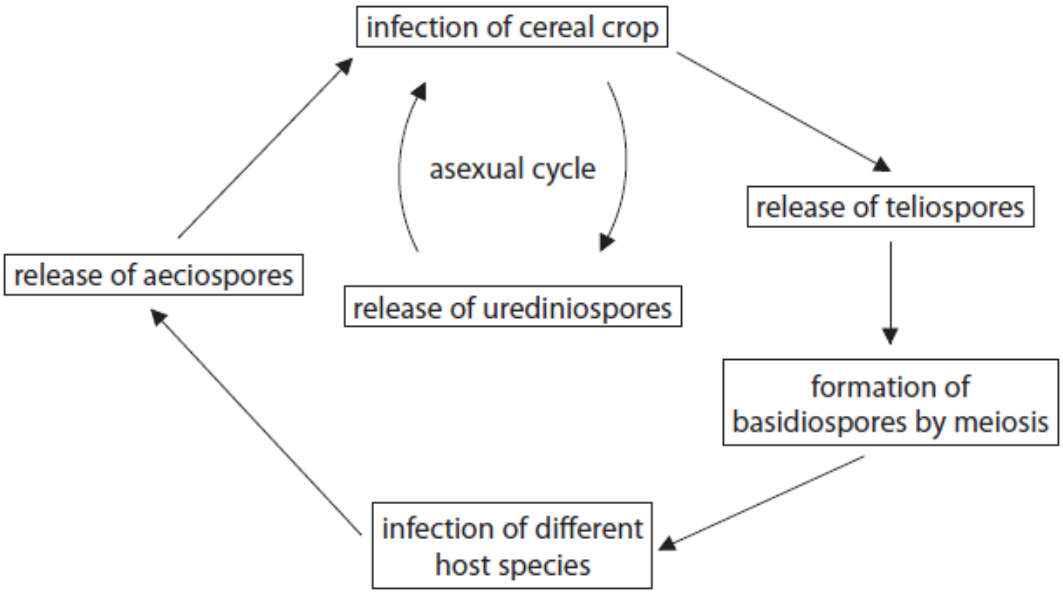
.....

.....

Q2.

The stem rust fungus is responsible for destroying cereal crops and reducing grain yield.

The diagram shows some stages in the life cycle of the stem rust fungus.



Cereal crops have been genetically modified (GM) to produce plants that are resistant to stem rust fungus.

Analyse the diagram to deduce why the formation of basidiospores and urediniospores can produce a stem rust fungus to which these GM plants are no longer resistant.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q3.

In July 2014, scientists announced that '*Tpl2*-KO' knockout mice were resistant to inflammation of the spinal cord.

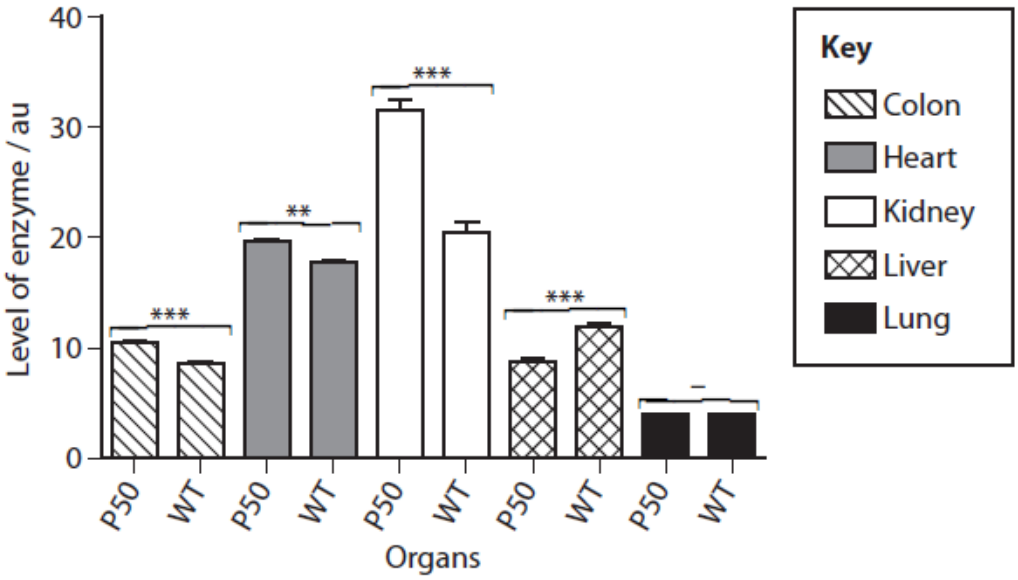
A different knockout mouse strain, called P50, has also been developed.

Premature ageing can be caused by overactive NAD dehydrogenase. This enzyme is found in mitochondria.

This enzyme can cause a build-up of superoxides that damage the mitochondria.

The graph shows the levels of NAD dehydrogenase in different tissues of P50 mice and in wild type (WT) mice. Significance levels for *p* are also shown.

*** -$p < 0.001$; ** -$p < 0.01$



Use the information in the graph to predict the probability of damage occurring to the mitochondria in the organs shown.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

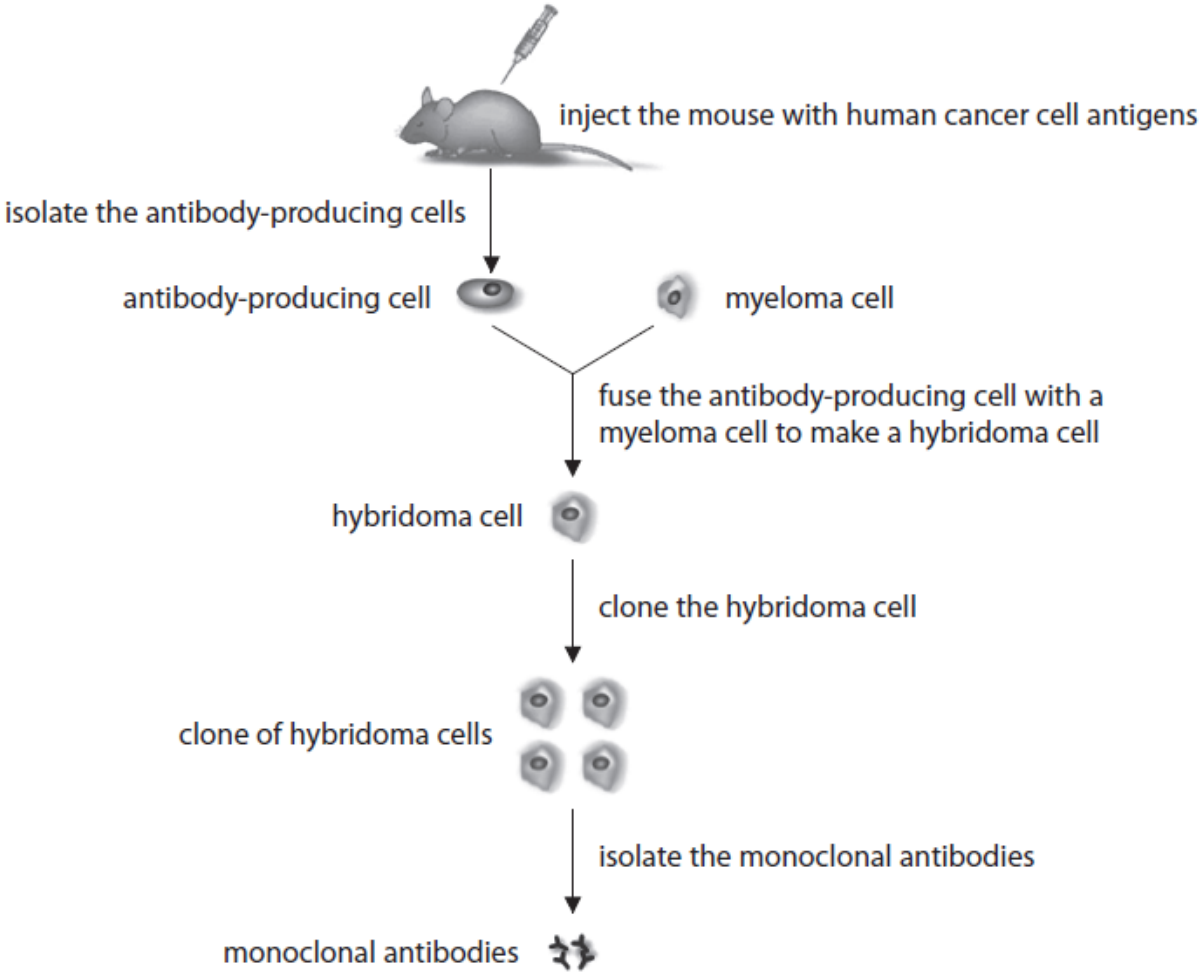
.....

Q4.

Monoclonal antibodies can be made against a wide range of different antigens. They are used in research and medicine.

Monoclonal antibodies are made by fusing an antibody-producing cell with a myeloma cell.

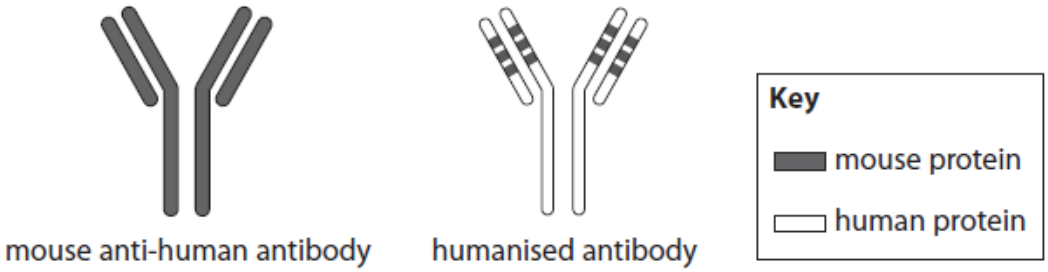
The diagram shows some of the steps involved in making monoclonal antibodies against human cancer cell antigens.



The antibodies made by this method are called 'mouse anti-human antibodies'. These antibodies are made by a mouse but are specific to human antigens.

Mouse anti-human antibodies are humanised using recombinant DNA methods.

The diagram shows a mouse anti-human antibody and a humanised antibody.



(i) Explain the advantages of using humanised antibodies in the treatment of cancer.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

* (ii) Explain why mouse anti-human antibodies need to be humanised in order to treat cancer.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 9 marks)

Q5.

Plasmids with genes for resistance to antibiotics are widely used in gene technology. These plasmids are used to create recombinant bacteria.

Explain how culturing could be used to obtain recombinant bacteria.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

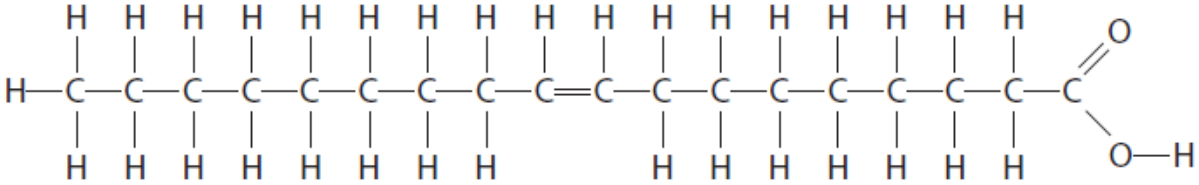
.....

(Total for question = 5 marks)

Q6.

Soya bean plants have been genetically modified (GM) to increase the concentration of certain organic molecules.

The diagram shows one of these molecules.



Describe how soya bean plants can be genetically modified to produce large numbers of GM soya bean plants.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q7.

Malaria is a serious and sometimes fatal disease.

Scientists are constantly looking for new ways of controlling this disease.

One group of scientists has genetically modified a fungus to produce a spider toxin that kills mosquitoes.

Describe how a fungus could be genetically modified to produce spider toxin.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 3 marks)

Q8.

Malaria is a serious and sometimes fatal disease.

Scientists are constantly looking for new ways of controlling this disease.

One group of scientists has genetically modified a fungus to produce a spider toxin that kills mosquitoes.

Another group of scientists has discovered a type of fungus that completely protects mosquitoes from infection by the pathogen that causes malaria.

This fungus does not kill the mosquitoes.

Explain why this approach is less controversial than the approach used by the scientists who are developing the genetically-modified fungus.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

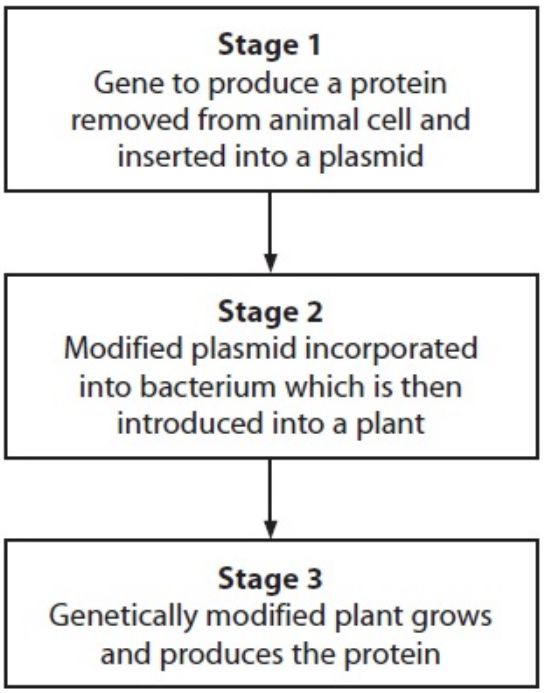
.....

(Total for question = 3 marks)

Q9.

Some organisms have been genetically modified to produce proteins including hormones and vaccines.

The flow diagram below shows part of a process to produce a protein, using genetically modified plants.



(a) Describe and explain the role of the enzymes involved in stage 1.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(b) Describe the structure of the modified plasmid used in stage 2.

(2)

.....

.....

.....

.....

.....

.....

(c) Suggest why plants rather than bacteria are used to produce the protein in stage 3.

(2)

.....

.....

.....

.....

.....

.....

(d) Describe **two** risks associated with the use of genetically modified organisms.

(2)

.....

.....

.....

.....

.....

.....

(Total for question = 11 marks)

Q10. The scientific article you have studied is adapted from several sources.

Use the information from the article and your own knowledge to answer the following questions.

(a) The sweet potato eaten by naked mole rats (paragraph 3) is very rich in starch. Starch can be a combination of amylose and amylopectin.

Give **two** structural differences between amylose and amylopectin.

(2)

.....

.....

.....

.....

.....

(b) Explain why a colony of naked mole rats is considered 'a eusocial society' (paragraph 4).

(2)

.....

.....

.....

.....

.....

(c) Naked mole rats show evidence of poikilothermy (paragraph 5).

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

(1)

.....

.....

.....

(ii) Suggest how each of the following 'contribute to poikilothermic responses to changing temperature of this mammal'.

(2)

'Lack of an insulating layer'

.....

.....

.....

'A marked reduction in sweat glands'

.....

.....

.....

(d) Suggest a mechanism that could have been used to genetically modify cells from mice with cancer-causing genes (paragraph 13).

(2)

.....

.....

.....

.....

.....

*(e) Whilst naked mole rats are 'impervious to chemical pain' they do feel 'acute pain such as cuts and burns' (paragraph 31).

Touching something hot, which could lead to a burn, can cause nerve impulses to travel along myelinated sensory neurones very rapidly.

Explain how myelination increases the speed of transmission of nerve impulses in a sensory neurone.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(f) Explain how a heart attack can temporarily reduce the oxygen concentration in brain tissue (paragraph 36).

(3)

.....

.....

.....

.....

.....

.....

.....

(g) Using the information in paragraph 48, name **one** hormone **and** state its function.

(1)

Hormone:

.....

Function:

.....

.....

.....

(h) Suggest how a change in the mid region of the sperm may make it non-motile (paragraph 48).

(2)

.....

.....

.....

.....

.....

.....

(i) Disperser naked mole rats 'are laden with fat' (paragraph 50).

Suggest why it may be advantageous for disperser naked mole rats to have high levels of fat.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

(j) Explain the statement that 'a preference by reproductively active females for unfamiliar males is interpreted as inbreeding avoidance' (paragraph 52).

(2)

.....

.....

.....

.....

(k) 'The naked mole rat hasn't yet had its genome sequenced' (paragraph 53).

Explain what is meant by the term **genome sequenced**.

(1)

.....

.....

.....

(l) 'With so much to offer science, it is no surprise that naked mole rats are becoming more common in labs' (paragraph 53).

Using information from the article, describe **two** adaptations of naked mole rats. For each adaptation, explain why it could be of interest in a medical research laboratory.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question = 30 marks)

Q11.

Soya beans are an important crop for the production of food and oil.

A study of the nutritional content of soya beans from non-transgenic soya bean plants and from transgenic soya beans plants was carried out in two regions of Brazil.

The regions were Ponta Grossa and Londrina.

Tables 1 and 2 show the results of this study.

Table 1

Type of plant	Region	Mean mineral content / mg per 100 g dried soya beans		
		Iron	Copper	Manganese
Non-transgenic	Ponta Grossa	3.34	0.76	1.38
Transgenic	Ponta Grossa	3.44	0.86	1.40
Non-transgenic	Londrina	4.59	1.35	2.20
Transgenic	Londrina	4.15	1.25	2.02

Table 2

Type of plant	Region	Mean organic content / mg per 100 g dried soya beans		
		Protein	Lipid	Carbohydrate
Non-transgenic	Ponta Grossa	38.61	21.09	23.88
Transgenic	Ponta Grossa	38.80	21.19	23.41
Non-transgenic	Londrina	41.68	18.56	25.74
Transgenic	Londrina	40.62	19.87	25.26

* (i) Analyse the data to assess the nutritional content of soya beans from transgenic and from non-transgenic soya bean plants grown in these two regions.

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(ii) The soil in Londrina is more fertile than the soil in Ponta Grossa. Londrina has higher temperatures and rainfall during the growing season.

Explain the differences in the nutritional content of soya beans grown in these two regions.

(5)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(iii) Explain why this study also analysed the types of fatty acid found in soya beans from transgenic plants and from non-transgenic plants.

(2)

.....

.....

.....

.....

.....

.....

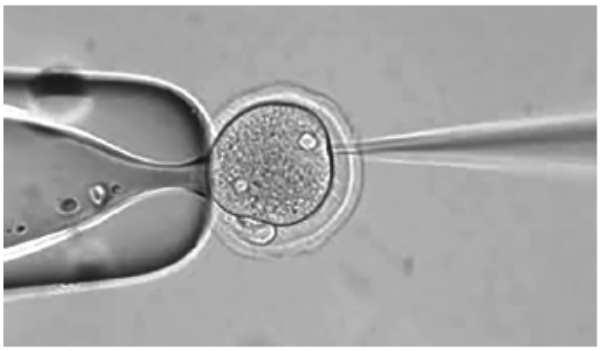
(Total for question = 13 marks)

Q12.

In July 2014, scientists announced that '*Tpl2*-KO' knockout mice were resistant to inflammation of the spinal cord.

Genetic modification of mammals can be carried out using microinjection of recombinant DNA. Microinjection of DNA has a low success rate.

The photograph shows this technique being carried out using a micropipette.



In an investigation, 275 eggs were microinjected with DNA. Eight of these resulted in the birth of a live mammal, one of which was transgenic.

(i) Calculate the percentage success rate for producing transgenic offspring.

Give your answer to two significant figures.

(2)

Answer ..... %

(ii) The success rate of DNA microinjection is lower in plants.

Plant cells have a cell wall and an internal turgor pressure. The micropipette used for DNA microinjection can cause a drastic loss of pressure and the plant cell dies.

An alternative technique is to place protoplasts into polyethylene glycol (PEG) containing the DNA. A protoplast is a plant cell with its cell wall removed.

PEG stimulates endocytosis.

This alternative technique had a success rate of up to 20% for producing genetically modified plants.

Analyse this information to explain why this alternative technique has increased the success rate of genetic modification.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Q13.

Prothrombin is involved in the blood clotting process.

The *F*2 gene codes for the synthesis of prothrombin.

A mutation of the *F*2 gene causes thrombophilia, a condition that results in the production of excess prothrombin.

A genetic test can be used to find out if a person has thrombophilia.

The test involves using a restriction endonuclease to obtain genetic material from white blood cells.

This genetic material is then used in the polymerase chain reaction (PCR).

(i) State the role of a restriction endonuclease.

(1)

.....

.....

(ii) Describe the process of PCR.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for question = 4 marks)

Q14.

The scientific article you have studied is adapted from articles in *Nature* and *Scientific American*.

Use the information from the article and your own knowledge to answer the question.

* Suggest how researchers had genetically modified the pathogen to 'provoke an effective immune response' (paragraph 12).

(6)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

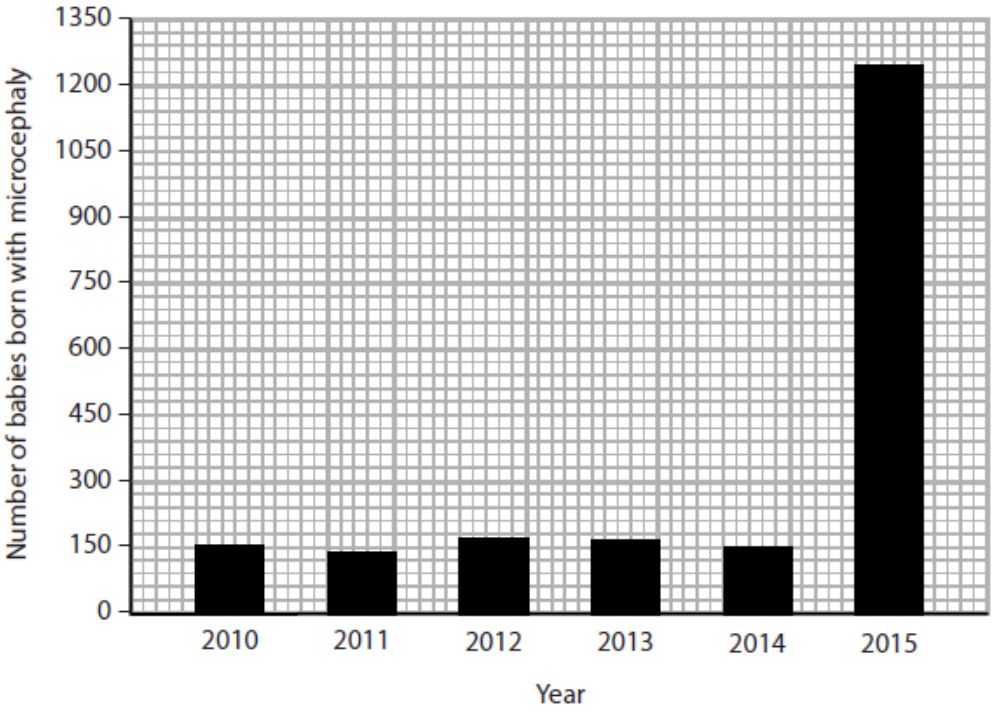
.....

Q15.

In February 2016, the World Health Organisation (WHO) declared a public health emergency because of the spread of the Zika virus.

The mild symptoms, such as joint pains, headaches and a slight temperature increase lasted only a few days. However, Zika virus has been linked to a birth defect called microcephaly.

The graph shows the number of babies born with microcephaly in Brazil from 2010 to 2015.



Zika virus is transmitted to humans by infected mosquitoes.

(i) Explain why another type of drug, rather than antibiotics, has to be used to treat Zika virus infections.

(2)

.....

.....

.....

.....

(ii) Scientists have suggested that genetically modified (GM) mosquitoes could be used to help combat the spread of the Zika virus.

Mosquito eggs are injected with DNA, from GM mosquitoes. This DNA contains a gene for fluorescence. However, only one in a few thousand injected eggs results in a GM mosquito.

Explain how this procedure could help in the production of large numbers of GM mosquitoes.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(iii) Explain why the Brazilian government has advised people to use mosquito nets, even if they have already contracted the Zika virus.

(2)

.....

.....

.....

.....

.....