

Surname	Centre Number	Candidate Number
Other Names		2



GCE A level

1075/01



S15-1075-01

BIOLOGY/HUMAN BIOLOGY – BY5

A.M. WEDNESDAY, 17 June 2015

1 hour 45 minutes

For Examiner's use only		
Question	Maximum Mark	Mark Awarded
1.	12	
2.	10	
3.	12	
4.	12	
5.	11	
6.	13	
7.	10	
Total	80	

ADDITIONAL MATERIALS

In addition to this examination paper you will need a ruler and a calculator.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

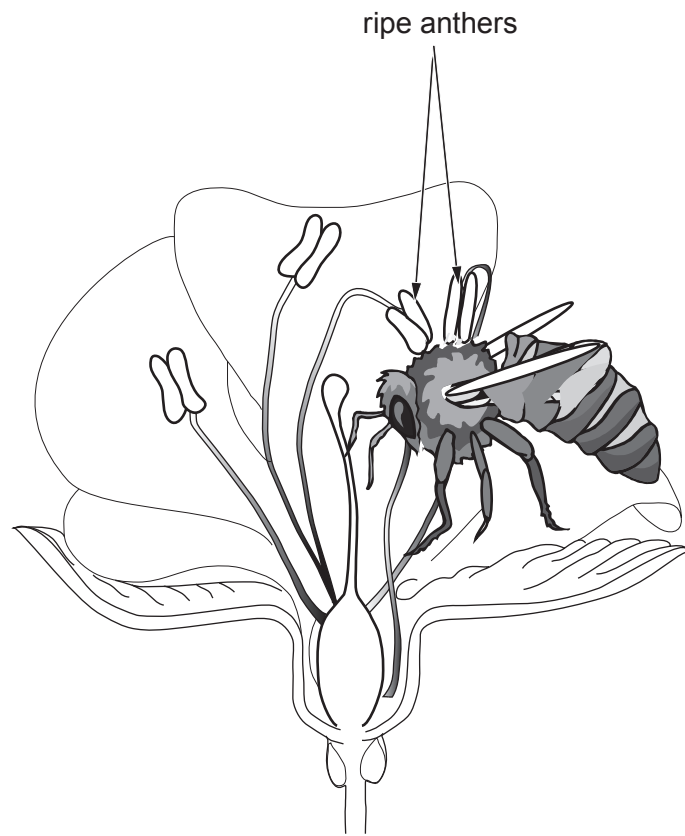
You are reminded of the necessity for good English and orderly presentation in your answers.

The quality of written communication will affect the awarding of marks.

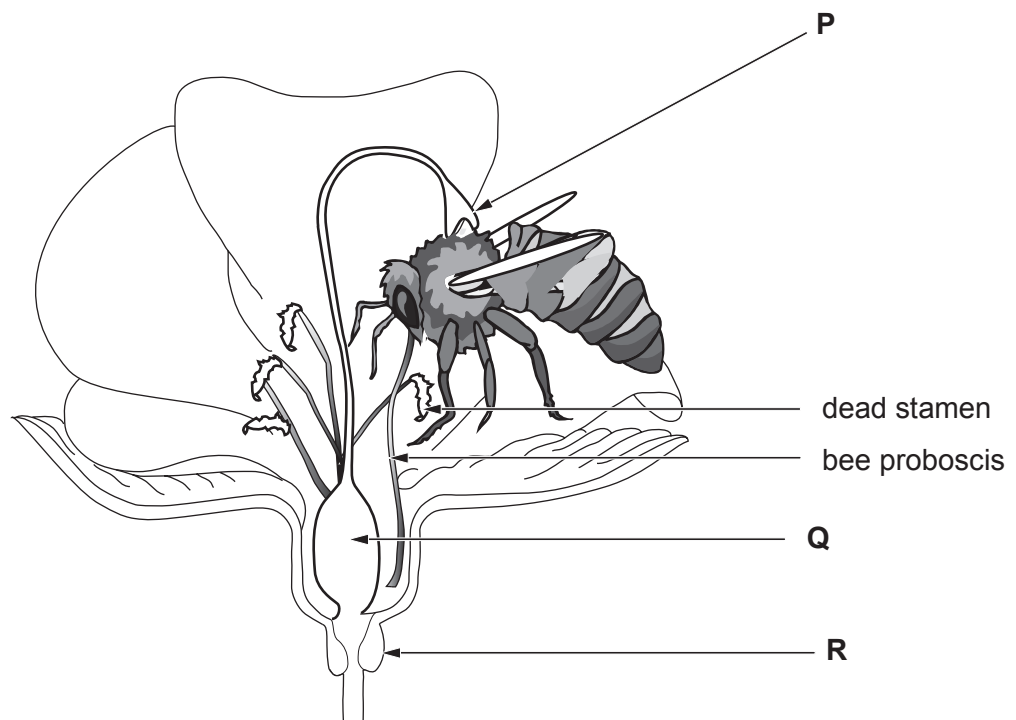
Answer all questions.

1. The diagrams below show pollination in an insect-pollinated flower.

I



II



(a) (i) Name parts: [1]

P

Q

(ii) Name the substance produced by structure R. [1]

.....

(iii) What is the function of this substance? [1]

.....
.....

(b) Describe what happens to the pollen in diagrams I and II. [2]

I.

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II.

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.....

(c) Using the diagrams opposite, explain how these flowers are adapted to ensure that;

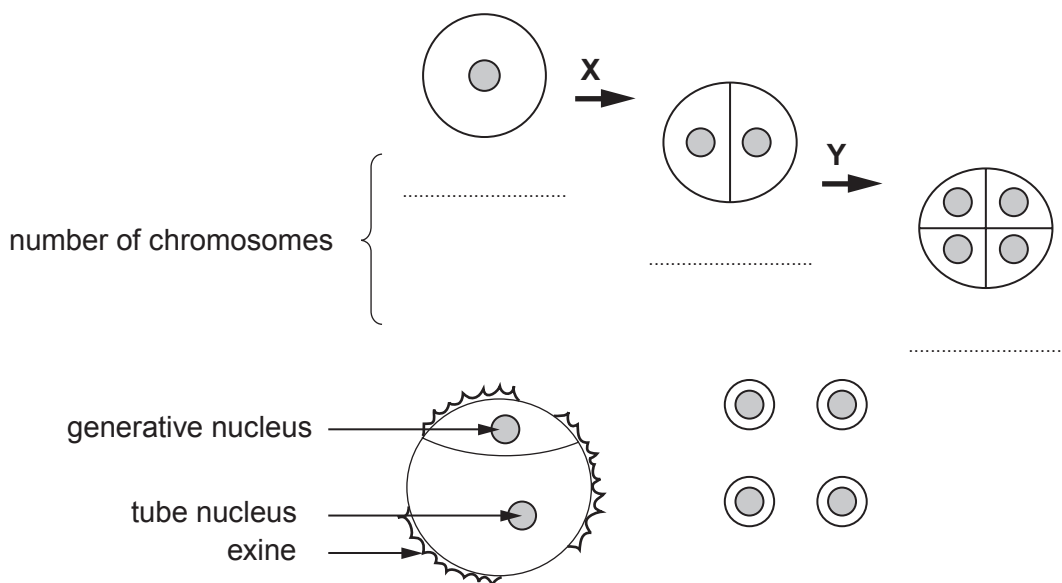
(i) there is effective pollen transfer between two flowers of the same species, [1]

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(ii) self-pollination is avoided. [1]

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(d) The diagrams below show the formation of pollen grains.



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(i) In which floral part does this take place? [1]

.....

(ii) Name the cell process represented by arrows X and Y. [1]

.....

(iii) The diploid number of this species is 10, underneath **each** structure indicated above, write the number of chromosomes in **each** nucleus. [1]

(iv) Give the functions of:

I. the generative (male) nucleus; [1]

.....

II. the tube nucleus. [1]

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2. There are three varieties of Labrador dogs; black, chocolate, and yellow. A student noticed that some yellow Labradors have black noses and some have brown noses. She proposed the hypothesis that the overall appearance is determined by fur colour **and** skin colour, as follows:

Variety	Fur colour	Skin colour
black	black	black
chocolate	black	brown
yellow (black nose)	brown	black
yellow (brown nose)	brown	brown

(a) The alleles for black fur (**B**) and black skin (**R**) are both dominant.

- (i) Draw a genetic diagram to illustrate a cross between two heterozygous black Labradors. [4]

Parental phenotypes	black fur, black skin	X	black fur, black skin
Parental genotypes	X
Gametes	X

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(ii) State the proportion of the offspring which would be, [1]
 chocolate
 yellow

(iii) State the proportion of the yellow offspring which would have brown noses. [1]

(iv) Suggest what simple observation of the chocolate Labradors could be used to support her hypothesis. [1]

(b) A dog breeder has a chocolate bitch which she would like to use to produce only chocolate pups.

(i) State the genotype of bitch the breeder should use to produce only chocolate pups. [1]

(ii) Describe the cross the breeder should carry out to test whether the bitch has the correct genotype. [1]

(iii) Which is the only variety of Labrador, if bred with the same variety, will always produce pups with the same phenotype as both parents? [1]

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3. (a) Meiosis is a type of cell division.

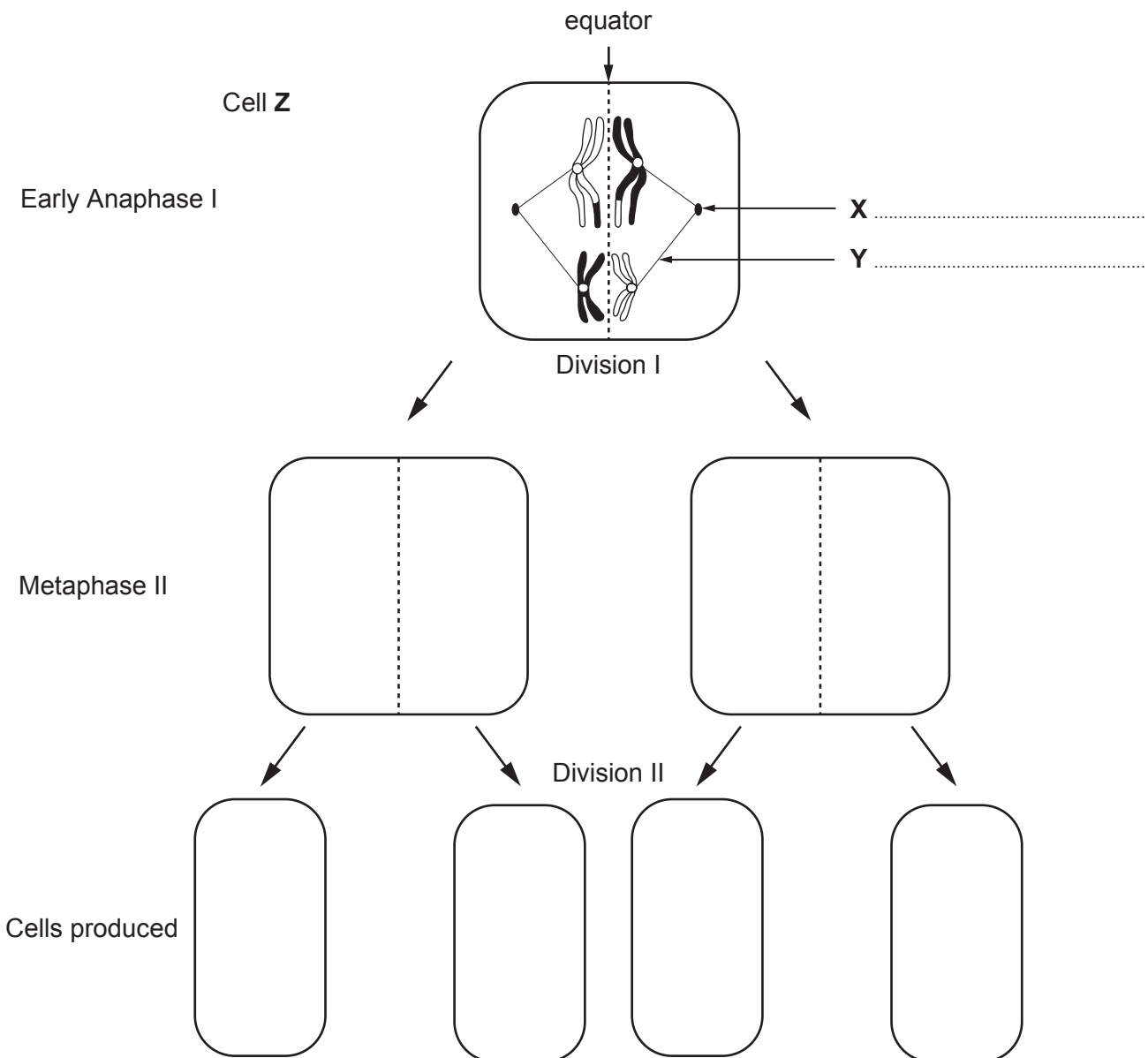
(i) State the purpose of meiosis.

[1]

(ii) Name the organs in animals where meiosis occurs.

[1]

(b) The diagram below represents meiosis in a cell with two pairs of chromosomes.



(i) Label parts X and Y.

[1]

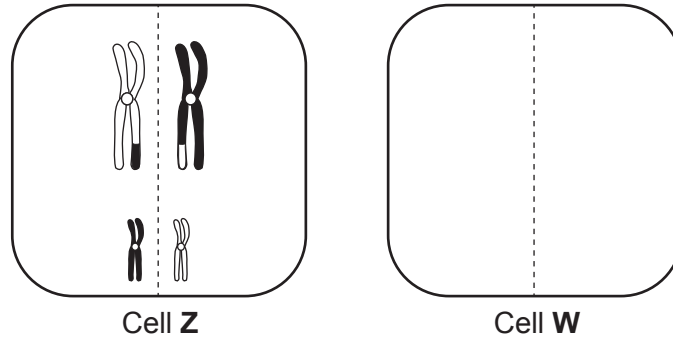
(ii) Draw chromosomes in the cell outlines for:

[4]

I. metaphase II

II. the cells produced

- (c) The drawing of cell **W** below is an outline of another cell from the same individual as cell **Z**. Complete the drawing of cell **W** to show how **independent assortment** could produce an alternative outcome. [1]



- (d) The drawing below shows the two larger chromosomes from cell **Z** at a different stage of meiosis.

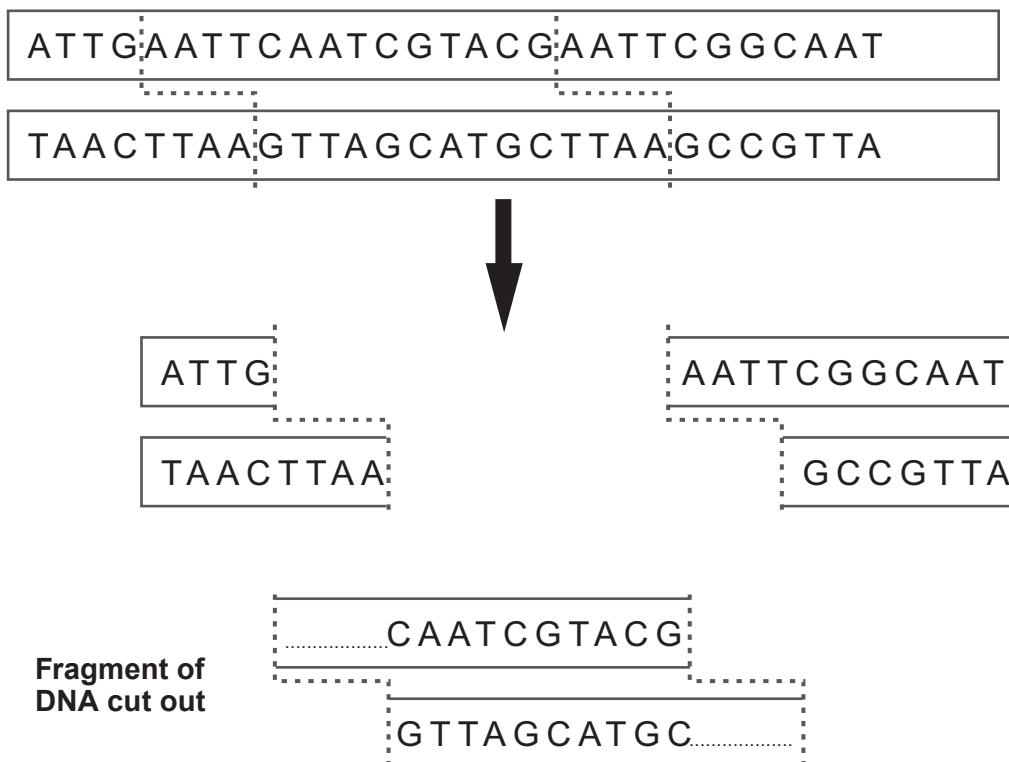


- (i) Name the stage of meiosis. [1]

- (ii) Explain with the aid of diagrams how the larger chromosomes in cell **Z** took on the appearance shown in part (c). [2]

- (iii) Name the process shown in your drawings. [1]

4. (a) Restriction enzymes are essential tools of genetic engineering. A restriction enzyme cuts the double-stranded DNA molecule at its specific **recognition site**. The diagram below shows how one such enzyme would cut out a DNA fragment.



- (i) Draw in the bases which are missing from the ends of the fragment of DNA which has been cut out. [1]
- (ii) Explain why the parts completed in (i) are known as 'sticky ends'. [1]
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- (iii) A number of different restriction enzymes are now available, some of which are shown in the table below:

Enzyme	Source	Recognition site
<i>EcoRI</i>	<i>Escherichia coli</i> RY 13	GAATTC
<i>BamHI</i>	<i>Bacillus amyloliquefaciens</i> H	GGATCC
<i>HindIII</i>	<i>Haemophilus influenzae</i> Rd	AAGCTT

Name the enzyme used in the example above.

[1]

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(b) In recombinant DNA technology, the piece of DNA which has been cut out is inserted into a plasmid which has been cut open using the same enzyme.

(i) Define the term 'plasmid'. [1]

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(ii) Why is it important to use the same enzyme? [1]

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(iii) Name the type of enzyme used to join the cut fragment into the plasmid. [1]

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(c) Restriction enzymes are also used to cut up DNA during DNA fingerprinting/profiling. Labelled DNA probes are then used to identify the positions of the fragments on an electrophoresis gel. The fragments used are sections cut from introns rather than exons.

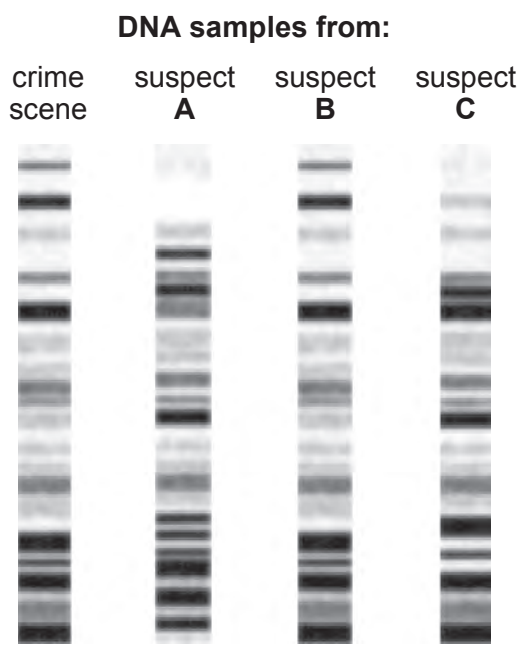
Explain why introns are more useful for genetic fingerprinting than exons. [2]

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(d) DNA profiles of a sample of DNA taken from a crime scene and samples prepared from blood of three suspects are shown below.



Give **two** features of the DNA profiles which would lead to the identification of suspect **B** as being present at the scene of the crime. [1]

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(e) (i) DNA at crime scenes is often found in very small quantities. Polymerase Chain Reaction (PCR) is a technique that enables the analysis of these small samples of DNA. State how PCR makes this possible. [1]

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(ii) The enzyme used in the technique has an important function during interphase in both mitosis and meiosis.

Name: [2]

- I. the enzyme used;
- II. the enzyme's function in interphase.

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5. Finches that inhabit the Galapagos Islands (which include the islands of Genovesa and Champion) have become known as Darwin's Finches. They provide useful evidence to support a gene pool model of speciation.

(a) Define the term 'gene pool'. [1]

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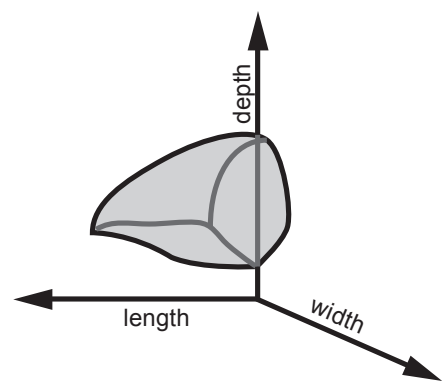
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(b) There is a strong correlation between the size of finches' beaks and the size of the seeds the beak is able to crack. Recent research has shown that two proteins are involved in controlling beak size:

Bone promoting molecule 4 (Bmp4) and calmodulin (CaM)

The diagrams below show links between the two molecules, beak shape and food source.

beak shape



Sharp-beaked Finch
mixed diet of seeds and insects

Low Bmp4 Low Beak Depth/Width
Low CaM Short Beak

Low Bmp4 Low Beak Depth/Width	Low-Mod. Bmp4 Medium Beak Depth/Width	Mod. Bmp4 Medium Beak Depth/Width	Early/High Bmp4 High Beak Depth/Width
High CaM Elongated Beak	High CaM Elongated Beak	Low CaM Short Beak	Low CaM Short Beak



Cactus Finch
probing cactus flowers/fruit



Large Cactus Finch
probing cactus flowers/fruit



Medium Ground Finch
crushing seeds



Large Ground Finch
crushing hard/ large seeds

(i) Describe the link between beak shape and food source. [1]

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(ii) Describe the link between CaM and beak shape. [1]

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(c) One theory for the evolution of the different species of Darwin's Finches is that a small population of Sharp-beaked Finch (*Geospiza difficilis*) was blown onto one of the islands from mainland South America. Over many generations they became adapted to feed on the different food sources available.

(i) Give **one** reason why, in the early generations of the island colony, the frequencies of the alleles responsible for producing Bmp4 and CaM might have differed from their frequency in the mainland population. [1]

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(ii) Explain how, in subsequent generations, the frequency of the allele responsible for producing CaM would have increased on an island where the main food source was cactus flowers. [4]

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(d) The Large Cactus Finch (*Geospiza conirostris*) from the island Genovesa has a beak that closely resembles that of the Cactus Finch (*Geospiza scandens*) from the island Champion.

(i) State why these two finches are considered to be separate species. [1]

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(ii) Explain why they evolved into separate species. [2]

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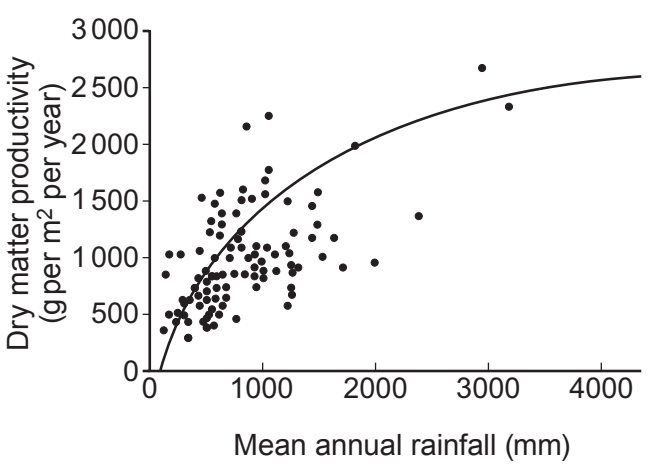
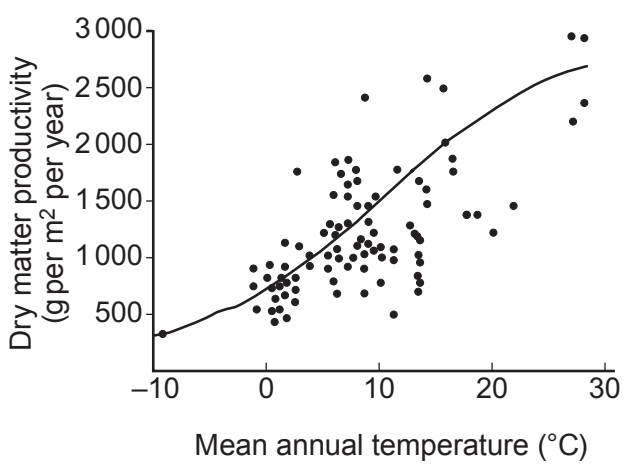
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6. (a) (i) Describe what is meant by the photosynthetic efficiency of a plant. [1]

(ii) Distinguish between Gross Primary Production (GPP) and Net Primary Production (NPP). [1]

(b) The rate of Primary Production is called Primary Productivity. The graphs below show the effect of two environmental factors on Primary Productivity.



(i) Describe the relationship between productivity and the **two** abiotic factors shown. [1]

(ii) Use this information to suggest why tropical rain forest is one of the most productive ecosystems in the world. [1]

- (c) Estimates of Net Primary Productivity for different types of ecosystem are given in the table below.

Type of Ecosystem	Average NPP (kJ/m ² /yr)
Tropical rain forest	35 280
Temperate forest	24 360
Northern coniferous forest	15 120
Woodland and shrubs	10 920
Lakes and streams	9 240
Agricultural crops	8 820
Desert	840

The average value for the solar energy striking the Earth's atmosphere is estimated at 4.41×10^7 kJ/m²/yr.

The ecological efficiency of tropical rain forest is $(35280 \div 4.41 \times 10^7) \times 100 = 0.08$

- (i) Calculate the ecological efficiency of agricultural crops. [2]

Answer

- (ii) Calculate the loss in Net Production for one year, if an area of tropical rain forest the size of Wales (21 785 km²) was cleared and used to grow sugar cane (an agricultural crop). [2]

Answer

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(iii) Explain why keeping cattle on the cleared land would be less efficient than growing crops. [2]

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(iv) Suggest a negative impact on the Earth's atmosphere of keeping large numbers of cattle. [2]

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(v) Suggest why growing sugar cane for producing biofuels could be considered carbon neutral. [1]

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