

Name	Date started	Target end date
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## GCE AS / A LEVEL – BIOLOGY UNIT 2 QUESTION PACK

1072-01 (Legacy BY2) · New spec Unit 2 Topic 2 · AS unit, first sat 2016, 80 marks, 1h 30min paper

# REVISE

.wales

## BIOLOGY – UNIT 2 · BIODIVERSITY, ADAPTATION & NATURAL SELECTION

### *BY2.2.2 Biodiversity – species diversity, sampling, adaptation and Darwinian natural selection*

*Defining species and biodiversity, calculating Simpson's diversity index, sampling with quadrats and transects, plus how variation, selection pressures and adaptation drive evolution by natural selection.*

#### LEGACY 2008 SPECIFICATION

#### Estimated time for entire question pack: ~1 h 12 min

*Derived from the legacy BY2 paper's pace of ~1.1 min/mark, padded for long-prose answers (45 marks over 6 questions).*

*You are advised to **not** attempt to complete all of this in one sitting.*

#### ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains every question from the legacy WJEC BY2 papers (2008 modular spec, 2011–2017) that maps onto new-spec AS Unit 2 Topic 2 (2.2).

Questions are ordered by source paper date.

#### INSTRUCTIONS

Use black ink or black ball-point pen. Show all working – quality of written communication will affect marks. A calculator is allowed. Diagrams included in answers must be fully annotated.

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Q	Source	Max	Mark	Q	Source	Max	Mark
1	Jun 11 Q1	6		4	Jan 13 Q1	9	
2	Jun 11 Q2	8		5	Jun 14 Q3	10	
3	Jan 12 Q2	7		6	Jun 15 Q1	5	
<b>Total</b>						<b>45</b>	

# Biodiversity, Adaptation & Natural Selection – what the new spec asks

WJEC GCE AS / A Level Biology (from 2015) · Unit 2: Biodiversity & Physiology of Body Systems · Topic 2.2.

## Defining biodiversity

- Species diversity, genetic diversity and habitat diversity.
- Species richness = number of species in an area.
- Simpson's diversity index  $D = 1 - \sum(n/N)^2$ .
- Higher D = more diverse, more stable ecosystem.

## Sampling methods

- Random sampling with quadrats – remove sampling bias.
- Belt and line transects – sample along an environmental gradient.
- Mark-release-recapture for mobile animals (Lincoln index).

## Adaptation

- Anatomical, physiological and behavioural adaptations.
- Adaptations fit organisms to their abiotic + biotic environment.
- Examples: xerophytes, cheetah morphology, swallowtail mimicry.

## Natural selection

- Variation in a population → selection pressure → differential survival.
- Survivors reproduce; their alleles increase in frequency.
- Over generations → adaptation, speciation (Darwin, Wallace).

# Biodiversity, Adaptation & Natural Selection in one page

Quick-reference notes – revisit before each question.

## Biodiversity

Variety of species, genes and habitats in an area.

High biodiversity ⇒ resilient ecosystem.

Threats: habitat loss, climate change, pollution, alien species.

## Simpson's index

$$D = 1 - \sum(n/N)^2$$

n = individuals of one species; N = total individuals.

D between 0 (low) and 1 (high diversity).

## Sampling

Quadrats – random for plants & sessile animals.

Transects (line / belt) – along a gradient.

Mark-release-recapture:  $N \approx (M \times C) / R$ .

## Adaptation types

Anatomical: cheetah body shape, finch beak.

Physiological: hibernation enzymes, antifreeze proteins.

Behavioural: migration, courtship, basking.

## Natural selection

1. Variation in a population.
2. Selection pressure (predator, climate, food).
3. Differential survival & reproduction.
4. Allele frequencies change over generations.

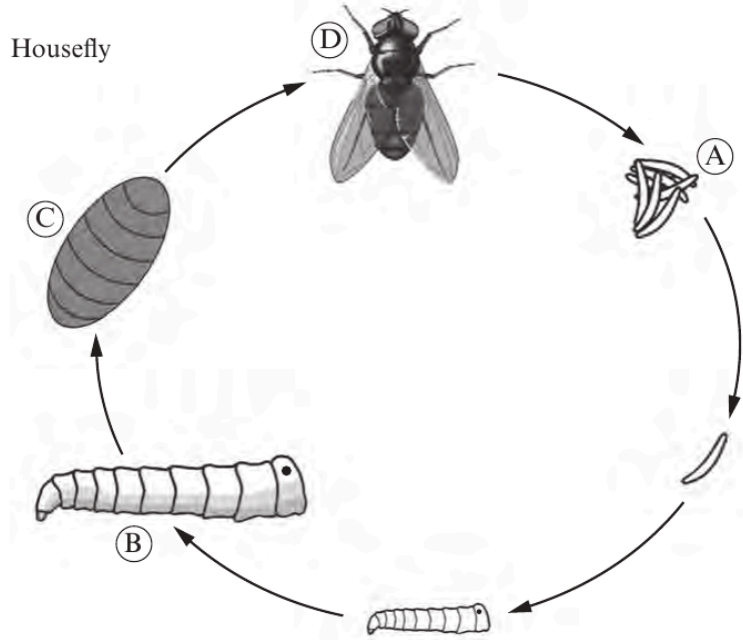
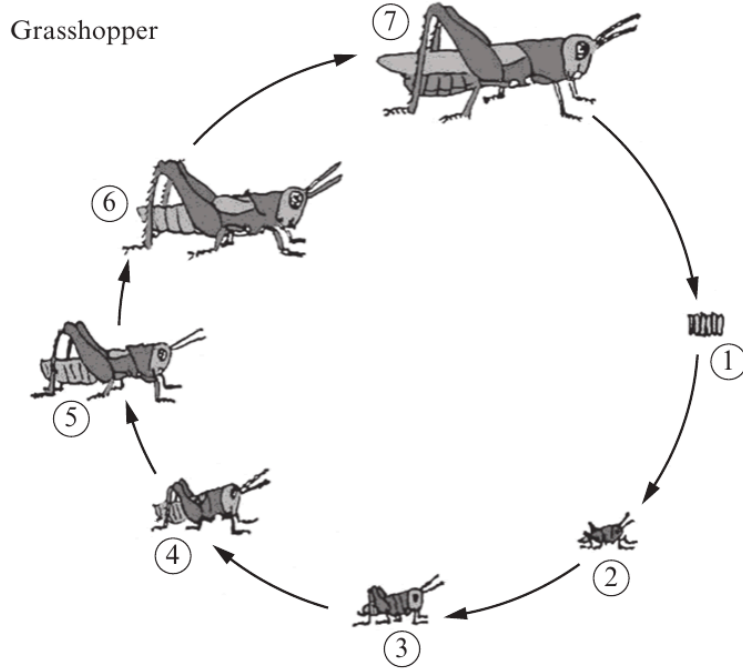
## Speciation

Allopatric: physical isolation (e.g. islands, mountains).

Sympatric: same area; ecological / behavioural / temporal isolation.

Darwin's finches: classic adaptive radiation.

1. The two diagrams below show life cycles of two different groups of insects (not drawn to scale).



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(a) (i) What name is given to the type of life cycle of the grasshopper? [1]

.....

(ii) Name the stages labelled

1, .....

7, .....

2-6. .... [2]

(b) (i) What name is given to the type of life cycle of the housefly? [1]

.....

(ii) Name the stages labelled

A, .....

B, .....

C, .....

D. .... [2]

**(Total 6 marks)**

2. Twenty thousand years ago, cheetahs (*Acinonyx jubatus*) roamed throughout the savannahs and plains of four continents: Africa, Asia, Europe, and North America.



About 10 000 years ago - because of climate changes - all but one species of the cheetah became extinct. With the drastic reduction in their numbers, close relatives were forced to breed and the cheetah became genetically inbred, meaning that all cheetahs are closely related.

- (a) Classify the cheetah. [3]

Phylum .....

Class .....

Genus .....

- (b) Name **one** feature that a cheetah has which allows the correct identification of each of its phylum and class. [2]

Feature of the phylum

.....

Feature of the class

.....

- (c) The drastic reduction in the numbers of cheetah results in the loss of genetic diversity in the population. What term is applied to this? [1]

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(d) (i) What biochemical method could have been used to determine that all cheetahs are closely related? [1]

.....  
(ii) What would the results show? [1]

.....  
.....

**(Total 8 marks)**

2. The photographs show two species of swallowtail butterfly.



Two-tailed Swallowtail  
(*Papilio multicaudata*)



Blue Mountain Swallowtail  
(*Papilio ulysses*)

(a) Butterflies belong to the same phylum as lobsters and spiders.

(i) Name the phylum to which these organisms belong. [1]

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(ii) Describe **two** features that all members of this phylum have in common. [2]

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.....

(b) Based on their physical characteristics the species of butterfly shown above are believed to be closely related. However, the Two-tailed Swallowtail is found in the USA while the Blue Mountain Swallowtail is found in Indonesia. It is possible that these species of butterfly may have become similar in form due to **convergent evolution**.

(i) State what is meant by the term *species*. [1]

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.....

(ii) Name the taxonomic **level** which suggests that the butterflies are closely related. [1]

.....

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(iii) Identify **one** method that could be used to confirm whether these butterflies are closely related or are the result of convergent evolution. [1]

.....

(iv) Describe how this method would show whether the butterflies are closely related. [1]

.....

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**(Total 7 marks)**

1. The species is the basic unit by which biodiversity is measured.

(a) Define the term *species*. [2]

.....  
 .....

(b) Some data on biodiversity is shown below.

	Estimated number of species		
	Britain	Borneo	World
Latitude (how far North of equator)	53°N	1° N	
Fish (freshwater)	38	394	>8500
Amphibians	6	100	>4000
Reptiles	6	105	6500
Birds (breeding residents)	210	600	9881
Mammals	48	288	4327

(i) Which vertebrate class in the table above shows the greatest biodiversity? [1]

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(ii) Using the table above, the percentage of the world's species of reptiles found in Britain was calculated as 0.09%. Calculate the percentage of the world's species of reptiles found in Borneo. [1]

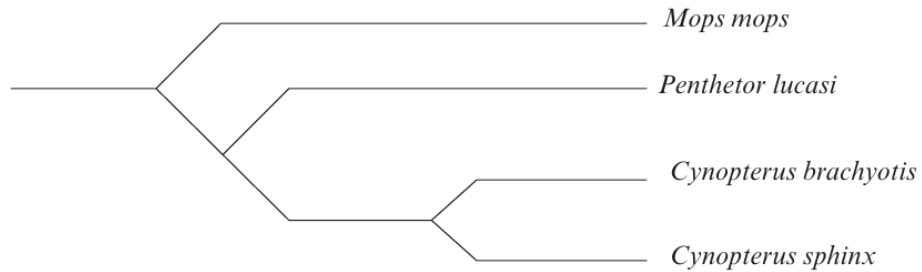
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(iii) Describe how the data above confirms the general pattern of biodiversity across the globe, from poles to equator. [1]

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- (c) There are 288 species of mammals in Borneo, of which 102 belong to the order Chiroptera (bats). The following diagram is a phylogenetic tree showing the evolutionary relationship between some of the bats.



- (i) Suggest, by marking an X on the phylogenetic tree above, the position of an ancestor common to *Pentheter lucasi* and *Cynopterus sphinx* but not common to *Mops mops*. [1]
- (ii) What do the latin names of *Cynopterus brachyotis* and *Cynopterus sphinx* tell us about their classification? [1]

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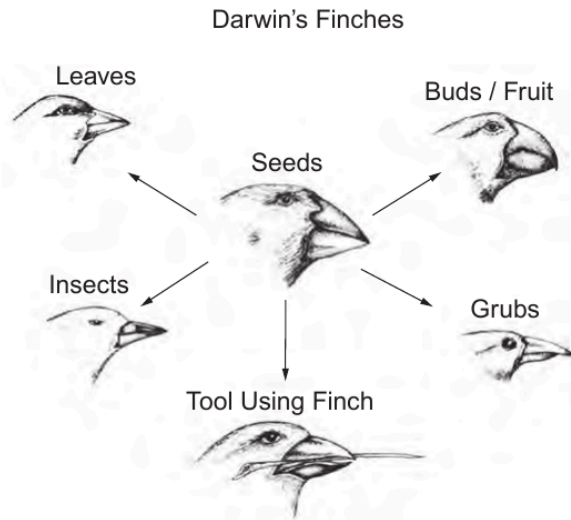
- (d) The wings of bats show similar morphology to the flippers of seals but have completely different morphology to the wings of insects. State the terms applied to structures that show

- (i) common structure but different functions; [1]
- .....
- (ii) common functions but different structures. [1]
- .....

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3. (a) Darwin's finches are an example of a species diversifying into several forms to ensure long term survival.  
The diagram below illustrates some of these different forms and their food sources.



- (i) Name the evolutionary change illustrated by Darwin's finches as shown in the diagram above. [1]

- (ii) Describe the process which results in the evolutionary change shown in the diagram above. [4]

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(b) Although haemoglobin is found throughout the animal kingdom, its amino acid composition varies.

Human haemoglobin is a protein molecule containing 574 amino acids. The haemoglobin of a horse has 557 amino acids in common with humans and the haemoglobin of a gorilla has 572 amino acids in common with humans.

(i) Explain what this information indicates about the evolutionary relationship between the three animal species. [3]

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(ii) Name the technique used to compare the amino acid composition of haemoglobin in different animals. [1]

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(iii) How has this biochemical technique helped improve the classification of organisms? [1]

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Answer **all** questions.

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1. The Snow Leopard, *Panthera uncia*, is an endangered species of big cat that is found in the mountainous regions of central Asia.

- (a) (i) Complete the table below for the classification of the snow leopard. [2]

Kingdom	Animalia
Phylum	Chordata
	Mammalia
Order	Carnivora
	Felidae
Genus	
Species	

- (ii) The snow leopard belongs to the phylum Chordata. Excluding characteristics common to the phylum in general, state **one** characteristic that is common to all vertebrates. [1]

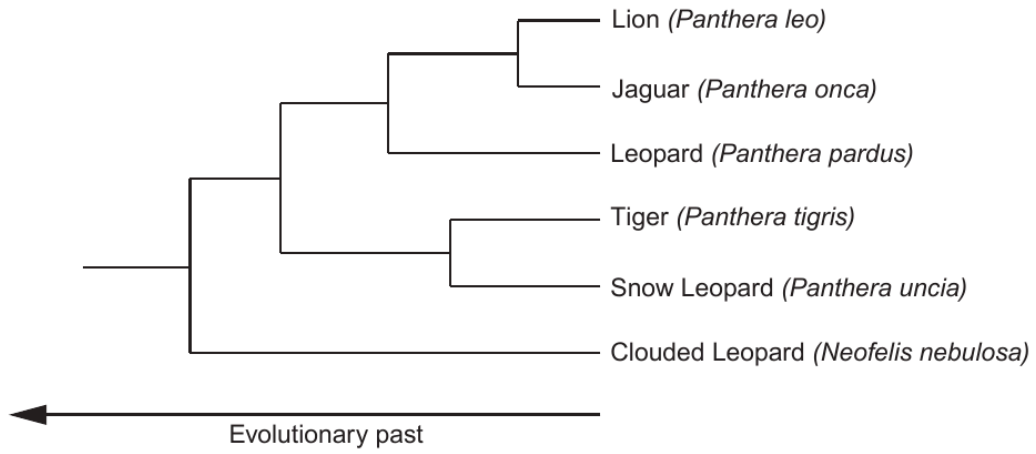
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(b) Below is part of the phylogenetic tree for the Felidae.



(i) Using evidence from the diagram, state which **two** cat species are likely to be most closely related. [1]

(ii) Explain how the results of DNA profiling tests could have been used to determine that these two species were the most closely related. [1]

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**END OF QUESTION PACK**

6 questions · 45 marks · ~1 h 12 min

Source: WJEC BY2 (2008 modular spec, 2011–2017)

Curated for WJEC Biology 2015 spec AS Unit 2 – Topic 2 (2.2)

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