



Answering Exam Questions: Classification and Keys

Examination questions relating to classification almost exclusively test factual knowledge. In order to answer the questions well, it is essential to learn the classification details that are included on the specification you are studying. The ability to apply your knowledge, or to observe data and apply it, may be tested by asking you to design or solve keys. This Factsheet should also help you to develop a good examination technique. Poor examination technique can lose you a lot of marks.

Example 1

- (a) (i) What is meant by the term 'taxon'? 1
 (ii) What is meant by the term 'species'? 2
 (b) List the following taxonomic groups in sequence according to the number of species they contain. Start with the group with the greatest number of species. 1
class family genus kingdom order phylum
 (c) Give three ways in which cells of the kingdom Prokaryotae differ from those of all other kingdoms. 3

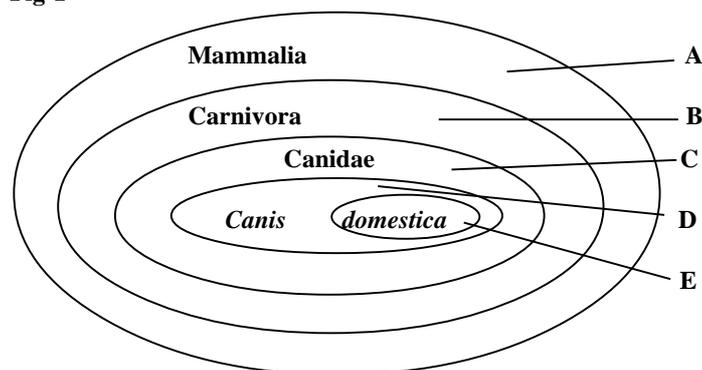
Answers and comments

- (a) (i) **A taxon is a grouping of organisms which share some basic features;** 1
 This would score the 1 mark available, so do not be tempted to expand your answer by detailing different levels of taxon (for example - kingdom, genus). Candidates often lose the mark by stating 'a taxon is a group of animals...' or 'a taxon is a group of plants ...'. The definition must embrace all organisms.
- (a) (ii) **A species is a group of organisms which can interbreed; to produce fertile offspring;** 2
 To score both marks you must indicate that the organisms can interbreed within the group, also that the offspring they produce are fertile/can also reproduce. Instead of giving the definition above, candidates often write 'a species is a group of similar organisms which cannot interbreed with other groups of organisms/are separated from other organisms by breeding barriers'. This is a negative answer – it is stating what a species cannot do, rather than what a species can do. At the most it would only score 1 of the 2 marks available.
- (b) The answer is **kingdom, phylum, class, order, family, genus;** 1
 Candidates often get this wrong, usually forgetting the sequence 'class, order, family'.
 A good idea to remember the sequence is to learn the saying 'King Philip Came Over From Germany'.
- (c) Any three of: **no nucleus; no membrane bound organelles/named organelles/mitochondria; don't divide by mitosis/divide by binary fission; have only 70S/small ribosomes; circular DNA/only one chromosome; have plasmids; cell wall made of murein; have slime capsule/fimbriae/pili;** maximum 3 marks
 Don't be tempted to give more than three points. If you list four points, one of which is incorrect, you will lose a mark. The question asks for prokaryotic features so don't be tempted to describe eukaryotic features. Try to give three distinct comments, for example, one relating to organelles, one relating to DNA and one relating to ribosomes. If you make two comments about organelles, for example, they may only score one mark because they are alternatives in the mark scheme rather than separate mark points.

Example 2

- (a) The mammals form a class called the Mammalia within the phylum Chordata. The domestic dog, *Canis domestica*, is a type of mammal. Fig 1 below shows the groups in the Mammalia to which the dog belongs.

Fig 1



- (i) Name the taxons A to E. 1
 (ii) The Brown Bear, *Ursus arctos*, belongs to another group in the Carnivora, called the Ursidae. Add this information in the relevant taxons, to Fig 1. 1
 (b) The diagrams below show two systems of classification of animals. Fig 2 shows a simple hierarchy. Fig 3 shows a phylogenetic system.

Fig 2

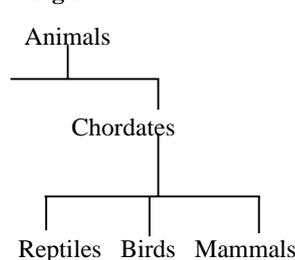
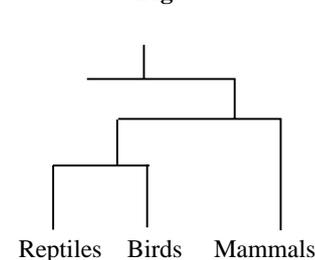


Fig 3



- (i) What is meant by a 'hierarchy'? 1
 (ii) Explain how a phylogenetic system differs from a simple hierarchy. Refer to figs 2 and 3 to illustrate your explanation. 4

Answers and comments

- (a) (i) **A = Class, B = Order, C = Family, D = Genus, E = Species;** 1
To score the mark all the taxons must be correctly named. There is no way around this – you must learn their sequence.
- (ii) **C – Ursidae, D – Ursus, E – arctos;** 1
To score the mark all three names must be written on Figure 1 in the correct positions. A common error made by candidates is just to write the names in the text – these answers would not score because the question asked for them to be put in the correct circles on the diagram. Another common error made by candidates in this type of response is to draw another set of three circles and to write the names in them. This approach would only score providing the circles for the Mammalia and Carnivora were also drawn. Remember the convention that generic names must start with a capital letter but specific names must only have small letters, for example, *Ursus arctos*.
- (b) (i) A hierarchy is **large groups split into smaller groups which do not overlap;** 1
Candidates commonly write ‘in a hierarchy the organisms are placed into groups’ which is not enough to score a mark.. To score the mark there should also be reference to the subdivision into smaller groups and to the non-overlapping nature of these sub-groups.
- (ii) **A phylogenetic system is based on evolutionary history; it indicates the ancestry of groups/shows points of divergence; for example, fig 3 shows that reptiles and birds separated after mammals/reptiles and birds are more closely related than mammals and birds/mammals and reptiles; a hierarchical system is based on shared characteristics; for example, in fig 2 reptiles birds and mammals are separated but given equal status;** maximum 4 marks
It is important that the question rubric is obeyed and that both fig. 2 and fig.3 are referred to in the answer – otherwise marks will be lost. Don’t just refer to the shapes of the diagrams – comments such as ‘more complicated/has more layers/like a staircase’ are often seen in answers to this type of question – they do not score marks. To score the marks reference must be made to the evolutionary biology involved, using both diagrams to illustrate your answer.

Example 3

- (a) The dodder, *Cuscuta epithimum*, is an unusual flowering plant. It is a parasite which grows on, for example, clover, gorse and heather. The adult dodder has no roots and has colourless leaves reduced to small scales.
- (i) Give one feature of the dodder which it shares with all other plants but does not share with organisms in other kingdoms. 1
- (ii) Complete the table below to show the classification of dodder.

Kingdom	
	Angiospermophyta
	Dicotyledoneae
	Monopetalae
	Convolvulaceae
Genus	
Species	

- (b) A gardener observed that common poppies and long-headed poppies in his garden appeared to be interbreeding to form hybrid poppies. Suggest how you could find out whether the common poppy and the long-headed poppy are different species. 3

Answers and comments

- (a) (i) **any feature shared by all plants but not shared by all members of any other kingdom – for example, cellulose cell wall/ large vacuole/permanent vacuole/show alternation of generations;** 1

A common error is to state a feature which is only common to flowering plants or gymnosperms, for example, ‘produces pollen/ovules/seeds’. Remember, the feature you state must also apply to mosses, liverworts, ferns, horsetails and club mosses.

(ii)

Kingdom	Plantae;
Phylum }	Angiospermophyta
Class	Dicotyledoneae
Order	Monopetalae
Family ; }	Convolvulaceae
Genus	Cuscuta }
Species	epithimum ; }

1 mark for ‘plantae’, 1 mark for ‘phylum + class + order + family’, 1 mark for ‘Cuscuta + epithimum’. 3

A common error is to mix up the sequence ‘class, order, family’. The genus and species names were given early in the question, - the genus name can be recognised because it has the capital letter. In questions like this, candidates often fail to read the question carefully enough, and miss these names.

- (b) **attempt to cross hybrid plants; by pollen transfer using a paint brush; if they produce seeds try to grow them; if they are different species seeds may not be produced/any seeds produced will not germinate/plants will be sterile;** max 3

It is not sufficient to cross the two types of poppy to see if hybrids are formed – the question tells you that this is so. The hybrids themselves must be crossed to see if they produce fertile seeds that will germinate to produce fertile offspring.

The word ‘viable’ is sometimes incorrectly used, instead of ‘fertile’. When ‘viable’ is applied to a seed, it simply means that the seed will germinate. The plant produced may still be sterile. The examiners in this type of question are looking for the term ‘fertile seed’ – that will germinate to produce a plant capable of successful sexual reproduction.

Example 4

The diagram shows an Amoeba. This is a single-celled organism.



- (a) Amoeba belongs to the kingdom Protocista. Explain why Amoeba is not,
 (i) a prokaryote, 2
 (ii) a fungus. 2
 Give a different answer for each case.
- (b) (i) Distinguish between radial symmetry and bilateral symmetry. 2
 (ii) Name a radially symmetrical animal and a bilaterally symmetrical flower. 2

Answers and comments

(a) (i) **presence of a nucleus; membrane bound/named organelles; only 80S ribosomes; no cell wall;** max 2 marks

(ii) **no cell wall; has no chitin; is motile; only one nucleus; has no hyphae;** max 2 marks

Note from the question that the answers must be different – ‘no cell wall’ will only be awarded once. To include the same point in both answers would be poor exam technique and would lose a mark.

(b) (i) **radial symmetry is when an animal/flower can be cut in any vertical plane to produce two mirror image halves; bilateral symmetry is when an animal/flower can only be cut down one vertical plane to produce two mirror image halves;** 2

Note that the two halves are ‘mirror images’ of each other. A very common error is to write that they are ‘equal or identical halves’. They are not.

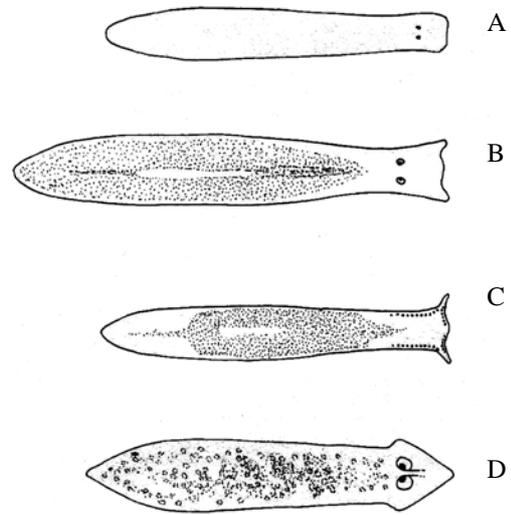
Often candidates are tempted to give extra information about the advantages of the two types of symmetry. Refrain from this, unless the question asks for it, because it wastes time and may lose marks if you make errors.

(ii) **any Cnidarian/Hydra/sea anemone/jelly-fish; any flower of the Papilionaceae/lupin/broom/vetch/gorse;** 2

Don’t be tempted to give more than one example in each case. A list of animals or flowers which includes an error will not score.

Example 5

The drawings below show the features of four different planarian flatworms.



Use the key below to identify the four flatworms, A, B, C and D.

- | | |
|--|------------------|
| 1. Many small eyes around the margin of the head | Polycelis |
| Two eyes near the centre of the head | go to 2 |
| 2. Head rounded with no obvious tentacles | Phagocata |
| Head with lateral or anterior tentacles | go to 3 |
| 3. Triangular head with lateral tentacles | Dugesia |
| Rounded head with anterior tentacles | Crenobia |

4 correct identifications = 4 marks

Answers and comments

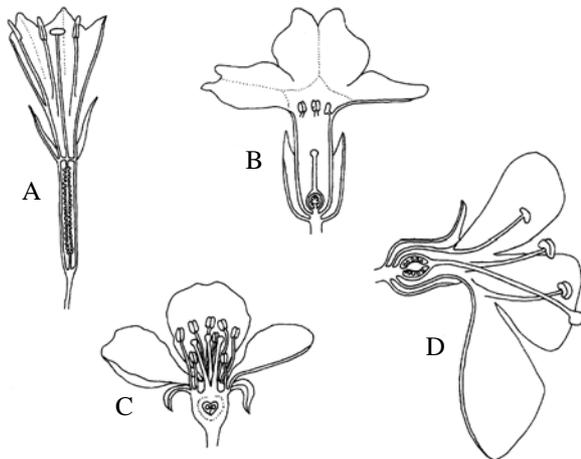
A = Phagocata; B = Crenobia; C = Polycelis; D = Dugesia; 4

This type of question is testing your ability to observe details of organisms and to apply your observations to solve a key. It is very important to read the key carefully and apply all the criteria within each step to your choice of organism.

Polycelis was actually identified in the first step of the key, but, because it had tentacles many candidates missed this (perhaps not observing the many small marginal eyes) and tried to identify it at step 3.

Example 6

The drawings below show four different flowers cut in half vertically.



(a) State three features shown in the drawings which could be used to distinguish between the flowers. 3

(b) Using only these three features, construct a simple dichotomous key to separate the flowers. 7

Answers and comments

(a) **radial symmetry versus bilateral symmetry; superior ovary versus inferior ovary/other floral parts attach to receptacle below ovary versus other floral parts attached to receptacle above ovary; floral parts/stamens basically in whorls of three versus floral parts/stamens basically in whorls of five; long stamen filaments versus short stamen filaments; filaments attached to petals versus filaments attached to receptacle; one stigma versus several stigmas; stigmas below anthers versus stigmas above anthers; numerous ovules versus few ovules;**

Any 3 for maximum 3 marks

The examiners would credit any other valid differences, provided they were visible on the drawings. To score the marks the feature and its comparison must be stated. For example, 'filament length' would not score but 'long versus short filaments' would.

Flowers have different symmetries' would not score – 'radial and bilateral symmetry' must be stated.

Although this question is testing your powers of observation and discernment, unless you have learnt floral structure thoroughly you will find it difficult to express what you see. It is essential that you learn your biology even for questions of this nature.

- (b) 1. Flower radially symmetrical go to 2;
Flower bilaterally symmetrical flower D;
- 2 Flower with several stigmas flower C;
Flower with a single stigma go to 3;
- 3 Flower with very short filaments flower B;
Flower with long filaments flower A;

truly dichotomous key;

1 mark per correct key step and one mark for a complete dichotomous key. 7

Obviously, a large number of different keys can be designed because the flowers show many differing characteristics. Examiners will give credit for any correct key.

An error in a key usually has a 'knock-on' effect, making later steps incorrect. Because of this examiners usually find it impossible to award marks after an error and so there is the potential, to lose a lot of marks. To reduce the risk of this, make sure that:

- you only use features seen in the drawings.
- you keep it simple – only use one contrasting feature per step – candidates often try to use two or more features per step, making it likely that errors will occur.
- make sure you only use two lines/alternatives per step (a dichotomous key). A common error is to have three lines/alternatives in a step. This is a trichotomous key which is not acceptable.

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