



**LEAVING CERTIFICATE EXAMINATION
2002**

BIOLOGY

HIGHER AND ORDINARY LEVELS

CHIEF EXAMINER'S REPORT

1. INTRODUCTION

This subject is assessed by means of a terminal written examination paper. The paper is divided into two parts, Part I and Part II. Part I is allocated 120 marks and Part II is allocated 280 marks. Candidates are required to answer six questions from seven in Part I, each question being allocated a maximum of 20 marks. Candidates are required to answer four questions from eight in Part II, each question being allocated a maximum of 70 marks.

2. PERFORMANCE OF CANDIDATES

Biology was taken by 22064 candidates in the Leaving Certificate examination in 2002. This represented 39.8% of the total Leaving Certificate cohort of 55432.

Higher Level

The Higher level paper was taken by 13773 candidates (62.4 % of the total number taking Biology). The percentages achieving each grade are outlined in Table 1.

Table 1 . Numbers and percentages achieving each grade in Leaving Certificate Biology Higher level, 2002

Grade	A	B	C	D	E	F	NG	Total
<i>Percentage</i>	14.6	29.2	28.8	19.5	5.6	1.9	0.3	99.9

The grades achieved by candidates in the years 2000 -2002 are outlined in the Appendix.

Ordinary Level

The Ordinary level paper was taken by 8291 candidates (37.6 % of the total number taking Biology). The percentages achieving each grade are outlined in Table 2.

Table 2 . Numbers and percentages achieving each grade in Leaving Certificate Biology Ordinary level, 2002

Grade	A	B	C	D	E	F	NG	Total
<i>Percentage</i>	5.8	21.6	28.5	25.4	11.6	6.5	0.7	100.1

The grades achieved by candidates in the years 2000-2002 are outlined in the Appendix.

3. ANALYSIS OF PAPERS

Higher Level

Table 3 outlines the popularity of questions in terms of the percentage of candidates attempting each question and the performance of candidates in terms of the average mark achieved in each question. The analysis is based on a random sample of 760 scripts.

Table 3. Popularity of questions and performance of candidates in Leaving Certificate Biology Higher level 2002

	Question Number	Popularity		Performance	
		Attempt Rate %	Rank Order	Average Mark	Rank Order
Part I	1	94.8	4	14.4	3
	2	96.7	3	13.8	5
	3	98.7	1	15.6	1
	4	94.0	5	12.1	6
	5	82.3	6	13.9	4
	6	97.7	2	14.8	2
	7	81.3	7	9.2	7
Part II	8	47.7	6	36.2	7
	9	51.7	3	38.5	5
	10	93.0	1	46.7	1
	11	16.4	8	30.0	8
	12	16.7	7	36.7	6
	13	51.3	4	45.5	2
	14	50.1	5	38.7	4
	15	88.9	2	41.3	3

Part I

- Q.1 (a) Most candidates answered this part correctly
- (b) The answers to this question were of varying quality. Graafian follicle was a common incorrect response, along with “ovary” and “ovule”.
- (c) This was not well answered. Many candidates gave the location of the Eustachian tube instead of its function.
- (d) The common botanical terms “corms” and “rhizomes” were not generally well known.
- (e) Many candidates were unable to state a correct function for guard cells.
- (f) Few candidates were able to give a more precise location for the pyloric sphincter than “in the stomach”.

- Q.2 This question was generally well answered but some responses would suggest an apparent lack of practical work in some schools.
- A minority of candidates only were able to state a use for alkaline pyrogallol
 - The answers to this question were of varying quality and the question was generally not well answered.
 - This was generally well answered.
 - This provided a mixed response. Common incorrect answers included “carbohydrates” and “sugars”. Some candidates suggested it was a test for DNA or protein.
- Q.3 This question was generally well answered and provided the highest average mark (15.6) in Part I. Some parts, however, were poorly answered.
- Duodenum - most candidates matched this correctly.
- Phytophthora* - this caused some problems and the most frequent incorrect match was “rhizoid”
- Endosperm - this was the least well-matched part, the majority of candidates matching it with “diploid” instead of “triploid”.
- Acrosome - this was poorly matched, in spite of a diagram of a sperm having appeared on the paper a number of times over recent years.
- Malpighian layer - this provided few problems
- Inhalation - this was nearly always correctly matched.
- Q.4 The response to this question was generally disappointing and the average mark was 12.1.
- Most candidates answered this part correctly.
 - This caused some problems. Many candidates gave “fern” as the answer
 - Some candidates lost marks by giving “flowering plant” rather than a **named plant** as required.
 - A minority of candidates lost marks by simply stating “plant”.
 - Most candidates answered this section correctly.
 - This was the least well-answered section. Very few candidates were familiar with the term “biennial”.
 - Most candidates answered this part correctly.
- Q.5 This question attracted a lot of adverse criticism from candidates after the examination and was the second least popular question in Part I (82.3%). The question demanded deductive reasoning and candidates were able to provide satisfactory explanations for the various questions relating to the graph. The answering was generally good, the average mark being 13.8.
- Q.6 This was a popular and well-answered question. Although the diagram quality had been criticised it did not appear to affect the performance of candidates. The average mark of 14.8 was the second highest in Part I. A number of candidates did not name the group to which the organisms belonged. In part (ii) Z was sometimes incorrectly called “cytoplasm”. W was sometimes

referred to as “substratum” or “rock”. As the relevant line did not reach the hapteron these answers were allowed.

- Q.7. This was the least popular and most poorly answered question in Part I. The average mark was 9.2. A better response would have been expected as most of the pairs of terms have appeared in previous examination papers. Candidates appeared to find it difficult to give precise, accurate answers to this type of question.
- (a) Many candidates gave the simplistic answer “control centre” for the nucleus. Few candidates could go beyond stating that the nucleolus is found in the nucleus.
 - (b) Most candidates gave a good answer for “antigen” but many candidates confused “antibiotic” with the term antibody.
 - (c) This was generally well answered.
 - (d) This part was not well answered and many candidates confused “coccus” with spirillum.
 - (e) Despite its regular appearance on the question paper the response to this part was generally poor. A majority of candidates knew the relationship between prothrombin and thrombin but were unable to make a correct comment on thrombin.

Part II

- Q.8 This question was attempted by 47.7% of candidates and the average mark achieved was 36.2%.
- (a) The structure of DNA was generally well known and a majority of candidates achieved full marks on this part. The role of DNA in heredity was not well known and candidates generally scored poorly.
 - (b) (i) The majority of candidates had difficulty in explaining the term “variation” and most did not get beyond a comment on different genotypes. In contrast, the question on mutation was almost always well answered.
 - (ii) Most candidates indicated that the statement was true. Few, however, were able to give adequate reasons as to why it was true. Typical answers amounted to no more than a paraphrase of the actual statement.
 - (iii) Candidates were generally able to state two agents of mutation.
 - (c) Few candidates gave worthwhile descriptions of evolution. Very many simply referred to changes in organisms and made no mention of populations or species. In relation to evidence for evolution candidates rarely gave an adequate definition of a fossil but most were well aware of the significance of the fossil record. The parts of the question on comparative anatomy and embryology were well answered. The notion of common descent or ancestry was rarely mentioned.
- Q.9 (a) This question was attempted by 51.7% of candidates and the average mark obtained was 38.5%. Seven points of information were required to secure maximum marks and the question was generally well answered. Some candidates were unable to distinguish between ‘transpiration’ and

‘transpiration stream’. Marks were also lost because water vapour was not mentioned in relation to transpiration.

- (b) The precise locations of the liver and pancreas were rarely given and candidates tended to respond with answers such as “in the abdomen”. Many candidates lost marks by confusing the digestive functions of the liver with its other functions. The roles of the pancreas were generally well known.
- (c) The standard of answering in this question dealing with experimental work with enzymes varied from very poor to good. It would suggest that practical work receives scant attention in some schools.

Q.10 This question, along with question 15, was significantly more popular than any other in Part II. 93% of candidates answered it and it scored the highest average mark at 46.7.

- (i) Most candidates were able to give sufficient information to earn the marks available but the concept of osmoregulation was rarely mentioned.
- (ii) Ecdysis posed few problems for candidates.
- (iii) Characteristics of the Echinodermata were generally well known.
- (iv) This part was not well answered. There was much confusion as to the precise roles of the earthworm’s circular and longitudinal muscles.
- (v) This was generally well answered. Marks were lost due to imprecise explanations such as “liver fluke cannot survive”.
- (vi) This part was not well answered. Many candidates responded with answers such as “earthworms are more specialised”.
- (vii) This was well answered.
- (viii) This was well answered.
- (ix) The characteristics of the Mollusca were generally well known.
- (x) This was not well answered. Many candidates stated simply that mammals do not possess an exoskeleton.

Q.11 This question and question 12 were significantly less popular than any other question on Part II. The average mark obtained in this question was 30.0. Examiners commented that the answering fell into two distinct categories – good and weak.

- (a)
 - (i) Most candidates knew what dry weight is but few were able to explain why it is used in experimentation
 - (ii) Many candidates gave temperatures that were far too low to achieve dry weight.
 - (iii) This question was generally well answered.

- (b) Where graphs were given they were mostly of poor quality. Having correctly labelled the y-axis many candidates drew an upward curve that was explained on the basis of water intake. Few candidates were able to explain the changes shown in their graphs.
 - (c) Those candidates who were able to correctly identify the two organelles generally proceeded to give good, clear diagrams. This was the part of the question where candidates scored most marks.
- Q.12. This question and question 11 were significantly less popular than any other question in Part II. The average mark obtained in this question was 36.7. While there were some good answers to individual parts of the question, the overall standard of answering was poor. It would seem that the topics examined in this question had been given little attention in schools.
- (a) Most candidates named the required trees correctly but diagram standards varied considerably. Those who drew specific parts of the tree generally scored well but those who merely gave overall diagrams of trees tended to score poorly.
 - (b) Some candidates gave very good and well-illustrated accounts of secondary thickening. Answers were, however, quite often marred by diagrams showing too many or too few rings. The terms secondary xylem and secondary phloem rarely appeared.
 - (c) The standard of notes was generally good and most candidates were able to give the required number of points.
- Q.13. This ecology question provided the second highest average mark.
- (a) This part, which required a number of definitions, was the most poorly answered. Most candidates were able to define predator and producer but had difficulty with the remaining terms. Succession and mesophyte, in particular, were poorly answered. These terms are all common components of the vocabulary of the ecology student.
 - (b) This was generally well answered. However, the answers in (i) and (ii) frequently did not match the named animal. In (v) few candidates could show how population size is calculated, in spite of this item having featured at regular intervals on the examination papers.
 - (c) The essay was generally very satisfactory.
- Q.14. (a) This was generally well answered. Answers to (i) and (ii) were almost invariably correct but “osmosis” was often given as the answer to (iii). Parts (iv) and (v) provided candidates with few problems.
- (b) The techniques required in this section were well known and most candidates scored well.
 - (c) (i) Most candidates answered “yes” but marks were often lost because the accompanying explanations were too vague. Comments such as “.....viruses need cells to live” appeared quite commonly.

- (ii) Few candidates were able to give the two required differences. Most simply gave the absence of a named cell structure.
- (iii) “Rabies” was the most common example given here. Very few candidates were able to name a viral disease of crop plants. A very common incorrect answer was “Dutch Elm disease”.

Q.15. This question, which contains an internal choice, proved very popular.

- (a) This was a popular question and most of those who attempted it scored well. Many candidates, however, lost marks by failing to mention water vapour in relation to transpiration. In (ii) conditions provoking guttation were poorly known and few candidates went beyond an unqualified mention of humidity. In (iii) diagrams of a potometer and descriptions of its use were generally good. As usual the cactus was the almost universally named xerophyte and the majority of candidates were able to give two adaptations.
- (b) (i) The demand for explanation of genetic terms produced a mixed response. Most candidates provided adequate definitions of allele and locus but there was general difficulty with homologous chromosomes and heterosomes.
 - (ii) The explanations of probabilities were mostly given in the form of an illustrated cross. Most candidates scored well but a significant minority seemed unaware of the concept of sex linkage and gave the male a pair of alleles.
- (c) This was the least popular and most poorly answered part. There had been a degree of criticism that there was insufficient human physiology on the examination paper and yet relatively few attempted this part.
 - (i) There was considerable confusion as to the relationship between blood and lymph
 - (ii) Only a minority were able to explain how lymph is circulated
 - (iii) Few candidates were able to give more than one transport and one defensive function of the lymph.
- (d) This was a popular and well-answered part. Few candidates, however, were able to give more than one function of thyroxine. The experiment in (iii) was generally well answered and most candidates were able to provide the required number of points.

Ordinary Level

Table 4 outlines the popularity of questions in terms of the percentage of candidates attempting each question and the performance of candidates in terms of the average mark achieved in each question. The analysis is based on a random sample of 600 scripts.

Table 4. Popularity of questions and performance of candidates in Leaving Certificate Biology Ordinary level 2002

	Question Number	Popularity		Performance	
		Attempt Rate %	Rank Order	Average Mark	Rank Order
Part I	1	98.7	4	9.6	4
	2	98.8	3	14.4	2
	3	72.2	7	10.4	3
	4	99.0	2	7.8	7
	5	94.0	5	8.1	6
	6	99.8	1	18.0	1
	7	88.7	4	9.3	5
Part II	8	76.5	1	40.9	2
	9	50.5	6	32.4	5
	10	46.5	7	33.5	4
	11	66.0	2	30.3	6
	12	65.5	3	41.2	1
	13	56.2	4	35.9	3
	14	44.0	8	26.2	8
	15	52.3	5	28.1	7

Part I

- Q.1 The standard of answering was generally poor especially in view of the fact that all parts had been asked in previous examinations. Parts (a), (d) and (e) caused most problems. “46” was given as the number of chromosomes in a human gamete, “ligaments” was identified as the tissue attaching muscle to bones and “arthropods” was given as the name of a group of organisms that has compound eyes.
- Q.2 The standard of answering in this question on human reproduction was good. Nevertheless “uterus” was often named as the structure where fertilisation takes place and part (d) was often left blank.
- Q.3 This was the least popular question in Part I but candidates scored reasonably well. Few candidates showed any understanding of how to know when all the water had evaporated from the soil sample. It would suggest that practical laboratory work is not being done in schools.
- Q.4 This multiple-choice question dealt with animal taxonomy and was a popular choice. Candidates, however, scored poorly and the average mark (7.8, less than 40%) was the lowest for Part I of the examination paper
- Q.5 Candidates scored poorly on this question on basic nutrition, much of which is included in the Junior Certificate Science course.
- Q.6 This True/False question was very popular and candidates scored well.

Q.7 This unpopular question on flowering plant structure resulted in a poor average mark. Many candidates had problems in correctly naming C (sepal) and D (carpel). Plant biology does not seem to be a popular choice with schools and examination candidates...

Part II

Q. 8 This question was the most popular in Part I.

(a) The diagram of an animal cell was generally well drawn and a common error was the appearance of a structure (cell wall?) outside the cell membrane.

(b) The explanation of characteristics of living organisms proved difficult for many students. The processes in *Amoeba* were reasonably well explained with the exception of excretion, which was confused with egestion.

Q. 9 (a) Labelling the parts of a plant caused some problems, especially B (bud), D (root) and C (petiole)

(b) The diagram of the leaf was usually reasonably well drawn although there was a tendency to make all cells very square with pointed corners. The functions of the stoma and cuticle were generally well understood..

Q.10 (a) The three shapes of bacterial cell were generally well known, although “cone” was often mentioned as a type. It was also common to include a membrane-bound nucleus in the drawing. Uses of yeasts in industry or medicine were often ascribed to bacteria.

(b) Although six steps only were required in the description of the experiment, few candidates managed to describe the requisite number.

(c) The concept of an obligate parasite was alien to most candidates but most were able to name three viral diseases.

Q.11 This question on ecology was not very popular

(a) (i) Many candidates gave the correct answer for the average number of worms without evidence of a calculation.

(ii) The estimation of the total number of worms in the lawn caused serious problems for many candidates.

(iii) The benefits of worms to a soil caused few problems.

(b) Part (ii) – the effects of removing producers caused most problems here.

(c) This was generally well answered although candidates found it a problem to state an environmental factor measured. Many candidates were confused about the concept of pyramid of numbers and found it

even more difficult to explain the limited number of levels in a pyramid.

- Q.12 The answering in this question resulted in the highest average mark in Part II.
- (a) Stating reasons for placing an insect in the phylum Arthropoda and drawing a diagram posed little problem for most candidates although the spiracle was not well understood.
 - (b) Most candidates named an insect and described its life cycle correctly. There was, however, confusion between ecdysis and metamorphosis.
 - (c) Many candidates were able to state two ways in which insects are beneficial and two ways in which they are harmful, but a number of candidates included spiders as insects in their answers.
- Q.13 (a) This part of the question was the least well answered and most candidates managed to explain only two of the three terms.
- (b) The genetic cross was generally well completed.
 - (c) The diagrams were generally quite well done and there seems to be a reasonably good understanding of mitosis. Some marks were lost on labelling.
- Q.14 This question scored the lowest average mark (26.2) and the main reason for this was the unwillingness or inability of candidates to attempt part (b) on plant histology.
- (a) Parts (i) and (ii) were well answered and part (iii) provided a mix of correct and incorrect answers.
 - (b) Many candidates did not attempt this part at all. A number of candidates did state a location for cambium.
- Q. 15 This question is generally very popular and tends to score well but this year it proved less popular and the average mark was significantly lower than last year's.
- (a) This part on enzyme activity, including an experiment, was the least popular part of the question. Many candidates gave factors that specifically affect photosynthesis as factors affecting enzyme activity. The experiment was poorly answered.
 - (b) This was quite a popular part of the question. Parts (i) and (ii) were generally well answered but few candidates managed to explain completely how the fungus obtains its food.
 - (c) This was quite popular and the diagram of the neuron was usually well drawn. The functions of the parts, however, were not well known. Many candidates used an example to explain a reflex action but many also included a connection to the brain as an essential part of the reflex arc.

- (d) This was a popular part of the question. Many candidates, however, attempted a formulaic equation instead of the word equation that was demanded. Parts (ii) and (iii) were well answered. The experiment in Part (iii) was poorly answered and some confusion existed with an experiment on respiration. De-starching and testing for starch was seldom mentioned.

4. OVERALL COMMENTS

Some of the comments made in the Chief Examiner's Report 2001 can be repeated here. There was a marked tendency for candidates to avoid questions on plant biology and/or to score poorly on them [HL Q.4 (part), Q.11, Q.12, OL Q.7, Q.9, Q 14 (b)], notwithstanding the fact that this forms a significant part of the Leaving Certificate Biology course.

There is continuing evidence of candidates' unfamiliarity with experimental work as shown by the answering in Questions 2, 9 (c), 11 (a) at Higher level and 10 (b), 11 (c), 15 (a), (d) at Ordinary level. There is additional evidence for this situation arising from much correspondence from pupils and parents following the examination where it is often stated that practical work is not a feature of the pupil's experience in school.

Criticism of the Higher level paper was focussed on questions 5, 9 11 and 15 (d). In relation to question 5, the basic critique was that "it was not biology" and "was not on the syllabus". The fundamentals of population dynamics are the same for all living organisms and section 10 (*Ecology*) of the syllabus deals with basic principles and concepts of ecology including competition, parasitism, food chain, limitations to population size and section 5 (*Microbiology*) deals with bacteria and disease, viruses and disease and pathogens, all of which are relevant to this question.

There was a degree of adverse reaction to question 9 (a) appearing on the paper and the criticism was mostly founded on a factually incorrect basis – e.g., pupils were being asked to describe a vivisection or pupils were being asked to describe the dissection of a rabbit. The question asked candidates to describe the dissection of a mammal and the rabbit was mentioned as a possible example. This topic appears in Section 4 (d) of the syllabus.

There was a degree of criticism by candidates that dry weight (Question 11) was an insignificant part of the syllabus. The concept of dry weight, however, is most important in biology for many reasons. All living organisms contain water and the role of water in living systems features in the syllabus [Section 4(g)]. As the percentage of water of an organism can vary considerably, comparative experimental results must be based on dry weight. Section 9 [The Soil] includes a simple experiment to determine the water content of soil and candidates should be aware of the required temperature to achieve loss of water. Section 8 [Reproduction and Development] deals with the digestion and utilisation of food resources in a seed and the weight changes occurring during germination.

Question 15 (d) asked candidates to describe an experiment that could be carried out to investigate the effect of thyroxine or iodine concentration on the metamorphosis of frog tadpoles. The collection of frogspawn for educational purposes is permitted by a licence that is issued under Section 23 of the Wildlife Act, 1976 to The Secretary-General, Department of Education and Science and his nominees (teachers of science subjects in post-primary schools) and is renewed annually.

5. RECOMMENDATIONS FOR TEACHERS AND STUDENTS

Plant physiology forms a significant part of the Biology syllabus [Section 4 (b), (c), (g) and also Section 8A (seed germination and embryo development)]. It is recommended that an appropriate amount of time be allocated to the teaching and learning of these elements and that relevant experimental work be undertaken in class.

The examination is designed to test the candidates' knowledge of the Biology syllabus as published in Rules and Programmes for Secondary Schools (published annually by the Stationery Office) and teachers should be familiar with this publication..

A considerable number of letters to the Chief Examiner expressed disappointment at the lack of a question on genetics. An examination of the paper shows that this is a misconception – Question 8 and question 15 (b) are drawn entirely from Section 6 (Genetics) of the syllabus and a candidate could have gained 105 marks (or 37.5%) from a total of 280 marks in Part II on genetics. Candidates should therefore be encouraged to read the question paper carefully before attempting to answer any question.

APPENDIX

Table 5. Grade distribution by percentage of results in Leaving Certificate Higher level Biology for the years 2000-2002

Grade	A	B	C	D	E	F	NG
2000	9.4	27.1	32.8	22.9	6.1	1.5	0.2
2001	13.0	26.2	29.8	22.5	6.7	1.7	0.2
2002	14.6	29.2	28.8	19.5	5.6	1.9	0.3

Table 6. Grade distribution by percentage of results in Leaving Certificate Ordinary level Biology for the years 2000-2002

Grade	A	B	C	D	E	F	NG
2000	3.8	20.0	26.9	27.4	13.2	7.4	1.3
2001	3.2	17.4	28.7	28.1	13.1	8.1	1.4
2002	5.8	21.6	28.5	25.4	11.6	6.5	0.7