Coimisiún na Scrúduithe Stáit
State Examinations Commission

LEAVING CERTIFICATE EXAMINATION 2005

PHYSICS AND CHEMISTRY

CHIEF EXAMINER'S REPORT
HIGHER AND ORDINARY LEVELS

Contents

1. INTRODUCTION

1.1 The Examination

Physics and Chemistry at both Higher and Ordinary levels is assessed by means of a terminal written examination of three hours duration, marked out of 400 marks.

The paper is divided into two sections:

- Section I – Physics (50%) and Section II – Chemistry (50%) – three questions are to be answered from six given questions in each section (66 marks each).
- The first question in each section (Question 1 and Question 7) consists of fifteen short items, of which eleven items are to be answered.
- The last question in each section consists of four parts; of which two parts are to be answered in Question 6 and three parts in Question 12 (two parts in Question 12 at Ordinary level).
- There is no compulsory question on either examination paper.
- Appropriate data are provided in the relevant questions on both papers.

1.2 Candidature

Table 1 shows the number of candidates sitting Leaving Certificate Physics and Chemistry for the last four years. The data are illustrated in Fig. 1. The data show a downward trend.

				Higher Level		Ordinary Level	
Year	**LC Candidates**	**% Taking Physics & Chemistry**	**Physics & Chemistry Candidates**	**Candidates**	**%**	**Candidates**	**%**
2002	55496	1.7%	969	654	67.5	315	32.5
2003	56237	1.7%	933	686	73.5	247	26.5
2004	55222	1.5%	815	604	74.1	211	25.9
2005	54069	1.4%	737	549	74.5	188	25.5

Table 1: Numbers of Leaving Certificate Physics and Chemistry candidates 2002-2005

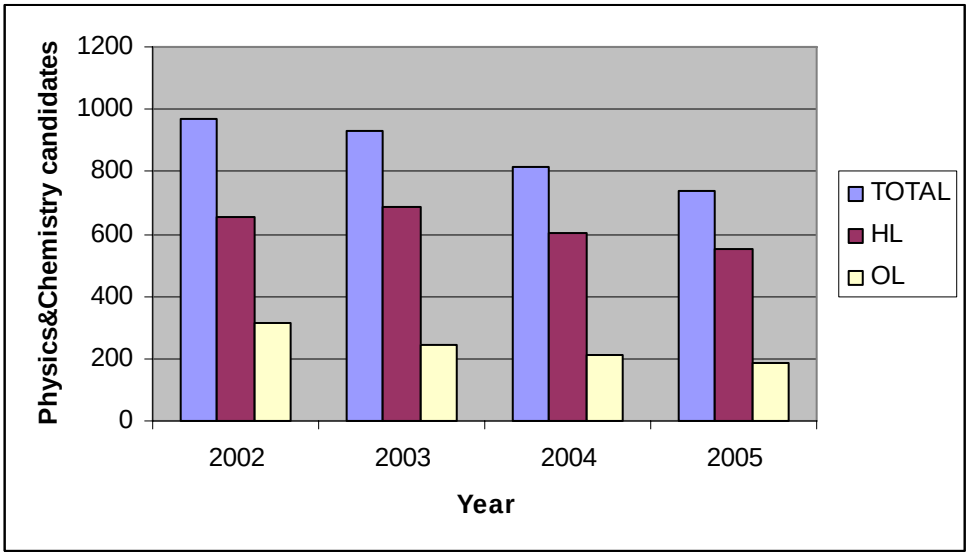


Fig. 1: Numbers of Leaving Certificate Physics and Chemistry candidates 2002-2005

2. PERFORMANCE OF CANDIDATES

Tables 2 and 3 show the numbers and percentages of candidates achieving each grade in the 2005 Higher Level and Ordinary Level Physics and Chemistry examinations. The appendix gives a more detailed analysis of the data.

Grade	**A**	**B**	**C**	**D**	**E**	**F**	**NG**
Numbers	112	181	131	89	22	12	2
% of candidates	20.4%	32.9%	23.9%	16.2%	4.0%	2.2%	0.4%

Table 2: Numbers of candidates achieving each grade in Higher Level Physics and Chemistry 2005

Grade	**A**	**B**	**C**	**D**	**E**	**F**	**NG**
Numbers	9	21	52	43	35	20	8
% of candidates	4.8%	11.2%	27.6%	24.5%	17.0%	10.6%	4.3%

Table 3: Numbers of candidates achieving each grade in Ordinary Level Physics and Chemistry 2005

Tables 4 and 5 show the average mark per question and the response rate in individual questions. The response rate is given as the percentage of candidates attempting each question in each section. Data in Table 4 are based on a random sample of 120 scripts, approximately 22% of the total Higher Level cohort. Data in Table 5 are based on a random sample of 40 scripts, approximately 21% of the total Ordinary Level cohort.

Section	Question	Topic	Average mark(%)	Rank order	Response rate (%)	Rank order
I	**1**	General	80	1	91	1
	2	Newton's 2nd law	78	2	79	2
	3	Waves and PE effect	67	4	31	5
	4	Boyle's law & CVGT	67	4	48	4
	5	Capacitance & electricity	54	6	28	6
	6	General	68	3	77	3
II	**7**	General	74	1	91	1
	8	Atomic theory	64	6	68	3
	9	Acid/base titration	70	5	62	4
	10	ECS & heat of combustion	73	2	80	2
	11	Organic	69	4	9	6
	12	General	71	3	57	5

Table 4: Performance of candidates and response rates in Higher Level Physics & Chemistry 2005

Section	Question	Topic	Average mark(%)	Rank order	Response rate (%)	Rank order
I	**1**	General	56	2	95	1
	2	Energy and motion	46	3	88	2
	3	Reflection of light	45	4	48	4
	4	Waves & PE effect	25	6	18	6
	5	Current electricity & electromagnetism	38	5	30	5
	6	General	57	1	65	3
II	**7**	General	52	1	75	2
	8	Atomic theory	45	3	78	1
	9	Electrolysis	51	2	43	6
	10	Acid – base titration	43	4	50	3
	11	Acid-base theory & organic	42	5	45	4
	12	General	27	6	45	4

Table 5: Performance of candidates and response rates in Ordinary Level Physics & Chemistry 2005

Comments

- In the Higher Level paper 4% of the candidates did not attempt the required three questions in each section, while 64% of candidates attempted more than the required three questions in each section.
- 45% of Ordinary Level candidates attempted more than the required number of questions.
- 90% of Ordinary Level candidates attempted three questions in each section.
- 25% of Ordinary Level candidates who were awarded grade E did not attempt the required number of questions.

3. ANALYSIS OF CANDIDATE PERFORMANCE

Higher Level

Section I – Physics
Questions 1, 2 and 6 were the most popular and best answered in this section.

Question 1 Average mark 80% Response rate 91%

This was the most popular and the best answered question on the paper.

The parts which were well answered were (a), (b), (c), (e), (f), (g), (i), (k) and (l).

(d) This was poorly answered with 'radio waves' frequently given as an example of a longitudinal wave, while some candidates simply described both waveforms.

(h) Many candidates did not get all the subscripts correct in the expression for the definition of temperature.

(j) There were all possible variations in the location of charge type, with many showing negative charges only on the second sphere.

(m) A number of candidates drew a straight line graph through the origin.

(n) Many candidates only gave one correct product for nuclear fission.

(o) Many candidates defined half-life in the singular, 'the time taken for half a nucleus to decay'

Question 2 Average mark 78% Response rate 79%

The second most popular and best answered question on the paper.

Candidates had no difficulty drawing the graph which had a good distribution of points. Almost all of the candidates drew the perpendiculars and correctly estimated the acceleration from the graph.

Question 3 Average mark 67% Response rate 31%

This was not a very popular question but was reasonably well answered by those who attempted it. The answers given for the measurements to be taken, in measuring the wavelength of light, contained a mixture from the Young's slits method illustrated in the question and the spectrometer. In the calculation many candidates were unsure of

the correct scientific notation for the nanometre (nm), while the weaker candidates mixed up the formulae**.**

Question 4 Average mark 67% Response rate 48%

This question was reasonably well answered. A significant number of candidates described Boyle's law using the J-tube of mercury which was surprising. The specific questions on the CVGT were challenging for many, in particular 'why the mercury is kept at mark M' and very few candidates got the correct answer to 'why a standard thermometer is necessary'.

Question 5 Average mark 54% Response rate 28%

This was not a popular question. In part (a) many candidates didn't give adequate answers for the factor on which capacitance depends 'area' and 'distance' were common and some candidates were unclear about the link between the divergence of the leaves and capacitance in the description of the experiment. In part (b) the definition for electric current was poor, quite a few described an experiment to demonstrate electromagnetic induction, and in part (ii) of the calculation 6 Ω rather than 12 Ω was used to calculate the current. The ammeter part at the end was not attempted by many.

Question 6 Average mark 68% Response rate 77%

A popular question and reasonably well answered. Parts (a) and (b) were the most popular while (d) was the least popular part

(a) Very few candidates achieved full marks in the description of the experiment to measure g, with the correct relationship between g and T and the correct slope of the graph poorly answered. Candidates found the calculations time consuming and quite a few had difficulty with the scientific notation and squaring the denominator.

(b) This part was well answered, a few had difficulty with the ray diagram of the telescope.

(c) Many candidates did not explain correctly the difference between the 'nature' and 'properties' of the beta particle. The nuclear equation was often incorrect with cobalt-59 rather than cobalt -60 being used. The calculations were poorly answered by most candidates.

(d) Candidates could not explain how the transformer worked and the reason why it loses energy; the calculations were well answered.

Section II – Chemistry

Questions 7, 8 and 10 were the most popular while questions 7, 8 and 12 best answered in this section.

Question 7 Average mark 74% Response rate 91%

This was the most popular and the best answered question in Section II.

The parts which were well answered were (a), (b), (c), (f), (h), (i), (j), (k) and (l).

The last three parts (m), (n) and (o) were based on the organic part of the syllabus and were poorly answered with the best attempt being made in part (n)

(d) The correct values were often given in reverse indicating that candidates did not differentiate between 'sub-shell' and orbital.

(g) Many candidates seem to have ignored the term 'non-metallic' in the question and incorrectly gave group 1 as an answer.

Question 8 Average mark 64% Response rate 68%

Many candidates showed a poor understanding of the basic principles of atomic theory. The electronic configuration was poorly answered, in particular Na^+, and very few candidates stated correctly the principle quantum number of sodium. When explaining why 'Be had a larger ionisation energy than B' many said that Be had a full outer shell, showing a lack of understanding of the terms sublevel, orbital and shell. The description of the crystal structure of sodium chloride was poor.

Question 9 **Average mark 70%** **Response rate 62%**

The definition of 'concentration' was poorly answered while parts (ii) and (iv) were well answered, there was a poor explanation in part (iii) as to why the sides of the flask were washed down. Very few got the correct titre value of 24. 05 cm^3 and those who had difficulty getting the equation correctly balanced, also had difficulty with the calculations.

Question 10 **Average mark 73%** **Response rate 80%**

This was the second most popular and best answered question in this section.
A number of candidates could not identify the substances oxidised. Candidates also lost marks for the incorrect order of the metals, while many incorrectly stated that a metal was found free in nature as it could be mined from its ore. Candidates did very well in part (b), with almost all candidates gaining full marks for calculating the heat of combustion of ethanol. However, 'heat evolved' rather than 'heat change' was very common in the definitions.

Question 11 **Average mark 69%** **Response rate 9%**

This was the least popular question on the paper. It was well answered by those who attempted it.

Question 12 **Average mark 71%** **Response rate 57%**

A reasonably well answered question. A small number of candidates only answered two rather than three parts.

(a) Candidates had difficulty in converting 250 kg to grams and in calculating the number of moles. The fact that the number of moles was large seemed to confuse the candidate and they divided the relative molecular mass by the mass.

(b) This was an easy question but poorly answered with many just guessing at the correct oxide. Very few got the correct equation for the reaction of the acidic oxide with water.

(c) This was well answered with some candidates failing to recognise the dibasic nature of sulphuric acid.

(d) This was the least popular part and was not well answered except for the calculation of the mass of sodium.

Ordinary Level

Section I – Physics
The most popular and also the best answered questions in this section were 1, 2 and 6.

Question 1 **Average mark 56%** **Response rate 95%**

This was the most popular and also one of the best answered questions on the paper. Pupils had difficulty with parts (d), (f), (i), (j) and (l). In part (f) candidates were of the impression that there were two separate processes going on at X and Y.

Question 2 **Average mark 46%** **Response rate 88%**

This was the second most popular question on the paper and was well answered Candidates had difficulty with the calculation in part (i) and in describing the energy changes in the final part – many simply referred to the change in speed.

Question 3 **Average mark 45%** **Response rate 48%**

This question was not very popular but was well answered by those who attempted it. Many candidates used the word refraction rather than reflection in the laws. The description of the experiment and the difference between real and virtual image was well answered. The calculation of the image distance was poor. A use for a convex rather than a concave mirror was frequently given.

Question 4 **Average mark 25%** **Response rate 18%**

This was the least popular question on the paper and one of the least well answered Candidates made a reasonable attempt at part (a). The explanation of the electromagnetic spectrum was poor. In part (b) many candidates were unable to describe how to give an electroscope a negative charge or explain how it loses its charge.

Question 5 **Average mark 38%** **Response rate 30%**

This was not a popular question and was poorly answered

Where this question was attempted candidates performed well in part (a) except for part (iii) of the calculations. Most candidates had a very poor knowledge of electromagnetic induction or its uses.

Question 6 **Average mark 57%** **Response rate 65%**

This was a popular question and was very well answered.

(a) Very few candidates were able to explain how the principle of conservation of momentum applied to the launching of a spacecraft. Not one candidate calculated correctly the velocity of the trolley after the collision.

(b) This part was well answered by those who attempted it.

(c) This part was poorly answered, candidates did not show the correct electric field pattern between the capacitor plates and many did not know the symbol for a capacitor.

(d) many candidates did not define radioactivity correctly, otherwise this part was well answered.

Section II – Chemistry

The most popular questions were 7, 8 and 9 while the best answered questions in this section were 7, 8 and 10.

Question 7 **Average mark 52%** **Response rate 75%**

This was a popular question and was well answered

Many had difficulty with parts (e), (f), (j), (l), (m) and (n), with only two candidates getting part (m) correct.

Question 8 **Average mark 45%** **Response rate 78%**

This was the most popular question in Section II. The standard of answering varied with many getting the *s,p* configuration wrong. In the final part many candidates did not 'give properties of this type of bond', many said 'ionic'.

Question 9 **Average mark 51%** **Response rate 43%**

This was the least popular question in this section but was very well answered by those who attempted it. The substances oxidised and reduced were often reversed as were the gases collected at X and Y. The information required in this question was very straightforward and suited the better candidate.

Question 10 **Average mark 43%** **Response rate 50%**

This was a popular question.

Candidates appeared to be very familiar with the experimental procedures of an acid-base titration. Marks were lost in the definition for the standard solution, precautions when using the burette and the final calculation.

Question 11 **Average mark 42%** **Response rate 45%**

This question was not popular and was poorly answered.

Many candidates did well in part (a) on the acid-base theory but performed poorly in part (b), in many cases this part was not even attempted.

Question 12 **Average mark 27%** **Response rate 45%**

This was one of the most poorly answered questions on the paper.

(a) The definition of the mole was answered fairly well but the calculations were poorly answered.

(b) Most candidates could not describe the preparation of sulphur dioxide but instead many gave the preparation of carbon dioxide.

(c) The order of the metals in the ESC was well answered, but the final part was poorly answered.

4. CONCLUSIONS

- Examiners agreed that the papers were very straightforward and well balanced, with clear unambiguous and fair questions . At Higher Level the standard of answering was higher than in previous years, with definitions well known. However, candidates experienced difficulty with calculations involving exponentials.

- At Ordinary Level the standard was lower than in previous years, and very few candidates attempted extra questions. Where candidates did not achieve a grade D or higher, many did not attempt the required number of questions.

- Ordinary Level candidates showed poor mathematical ability. In general, formulae were not known accurately, with the exception of the equations of motion.

- There was a strong tendency for candidates to avoid questions on electricity and organic chemistry at both levels.

- Where the performance of candidates was poor, there were two major causes: not answering enough questions and not answering fully the questions attempted.

- Able candidates attempted more than three questions in each section.

5. RECOMMENDATIONS

- It is essential that candidates study all sections of the syllabus and that they answer the required number of questions in the examination.

- There is a need to improve basic mathematical skills. In several calculations candidates substituted correctly but performed the basic computations incorrectly.

- The understanding of basic chemistry needs to be improved and attention needs to be given to definitions, balancing equations, and to the writing of chemical formulae and chemical equations. Likewise, attention needs to be paid to basic definitions in physics.

- It is important that plenty of experiments and demonstrations are undertaken to make the subject more engaging for candidates.

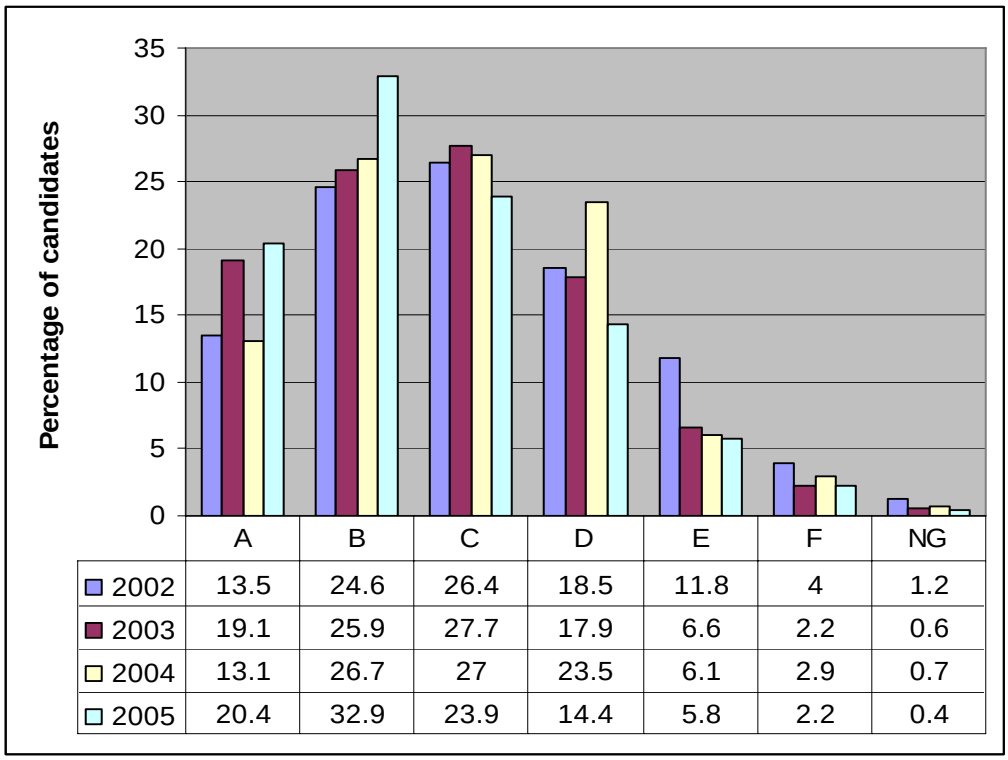
- Candidates need to experience a wide variety of practical and relevant situations in which they can apply their knowledge of the principles and concepts of physics and chemistry.

- Candidates need to be able to express their understanding of scientific concepts in language that is clear, concise and correct.

- A balanced coverage of both areas, physics and chemistry, is important so that candidates can attempt the required number of questions from each section of the paper.

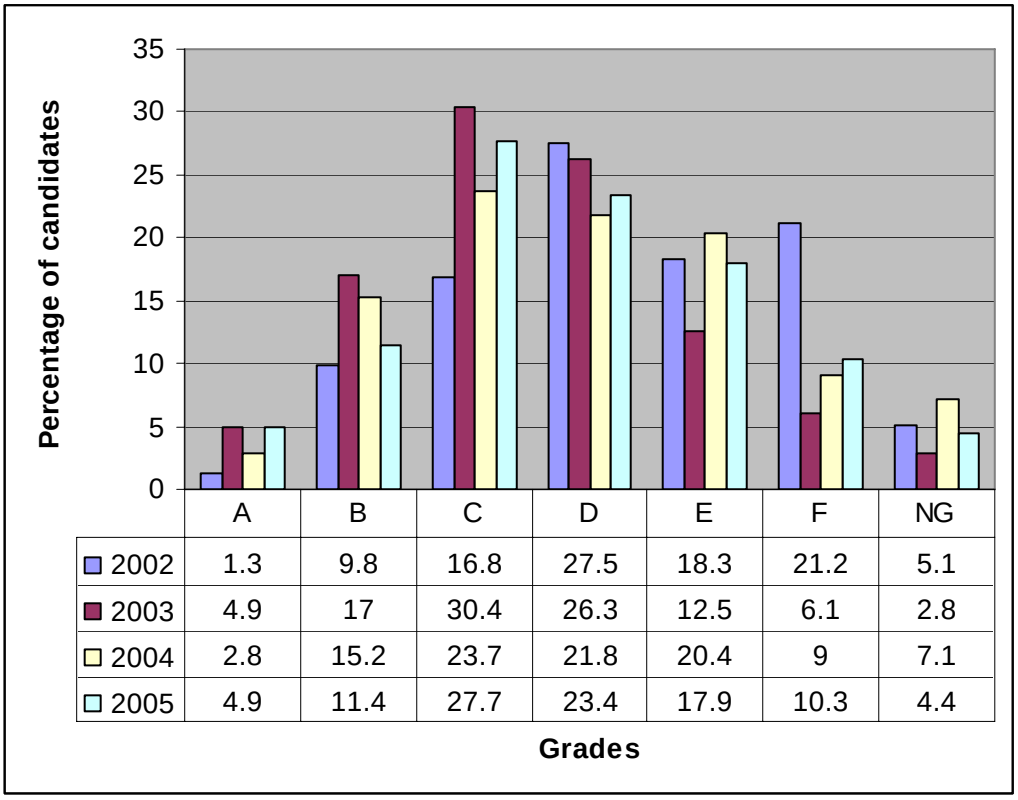
Appendix 1

Physics and Chemistry Higher Level grade distribution 2002-2005



	A	B	C	D	E	F	NG
2002	13.5	24.6	26.4	18.5	11.8	4	1.2
2003	19.1	25.9	27.7	17.9	6.6	2.2	0.6
2004	13.1	26.7	27	23.5	6.1	2.9	0.7
2005	20.4	32.9	23.9	14.4	5.8	2.2	0.4

Physics and Chemistry Ordinary Level grade distribution 2002-2005

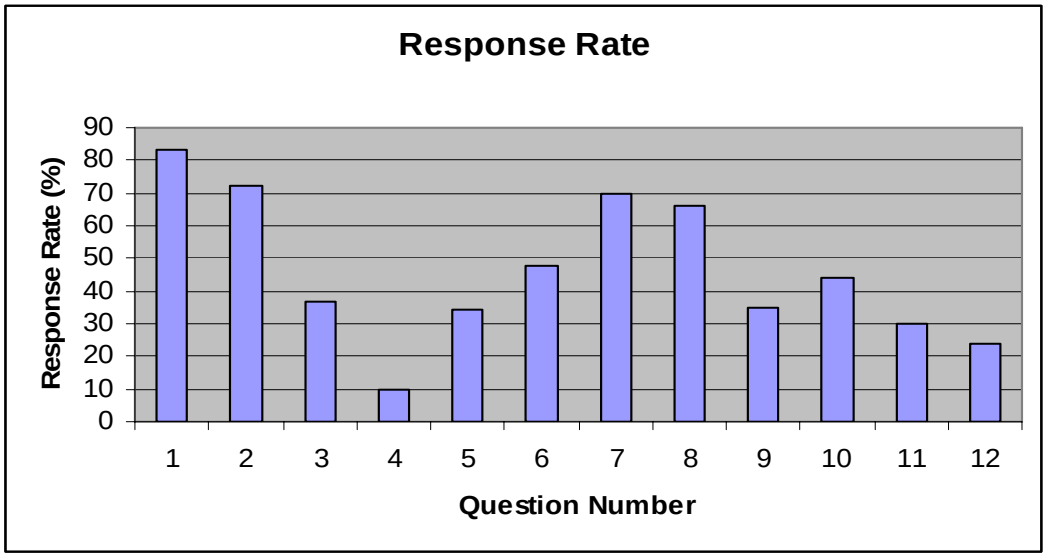


	A	B	C	D	E	F	NG
2002	1.3	9.8	16.8	27.5	18.3	21.2	5.1
2003	4.9	17	30.4	26.3	12.5	6.1	2.8
2004	2.8	15.2	23.7	21.8	20.4	9	7.1
2005	4.9	11.4	27.7	23.4	17.9	10.3	4.4

APPENDIX 2

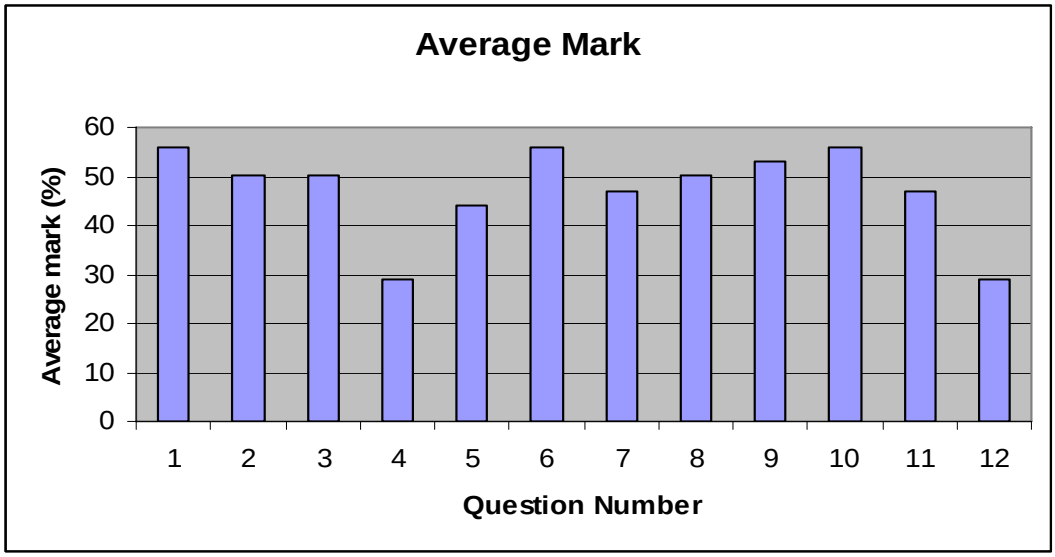
Physics and Chemistry O. L. 2005

Response Rate (%) (184 scripts)



Question	1	2	3	4	5	6	7	8	9	10	11	12
Response Rate (%)	83	72	37	10	34	48	70	66	35	44	30	24

Average mark (%)



Question	1	2	3	4	5	6	7	8	9	10	11	12
Average Mark (%)	56	50	50	29	44	56	47	50	53	56	47	29