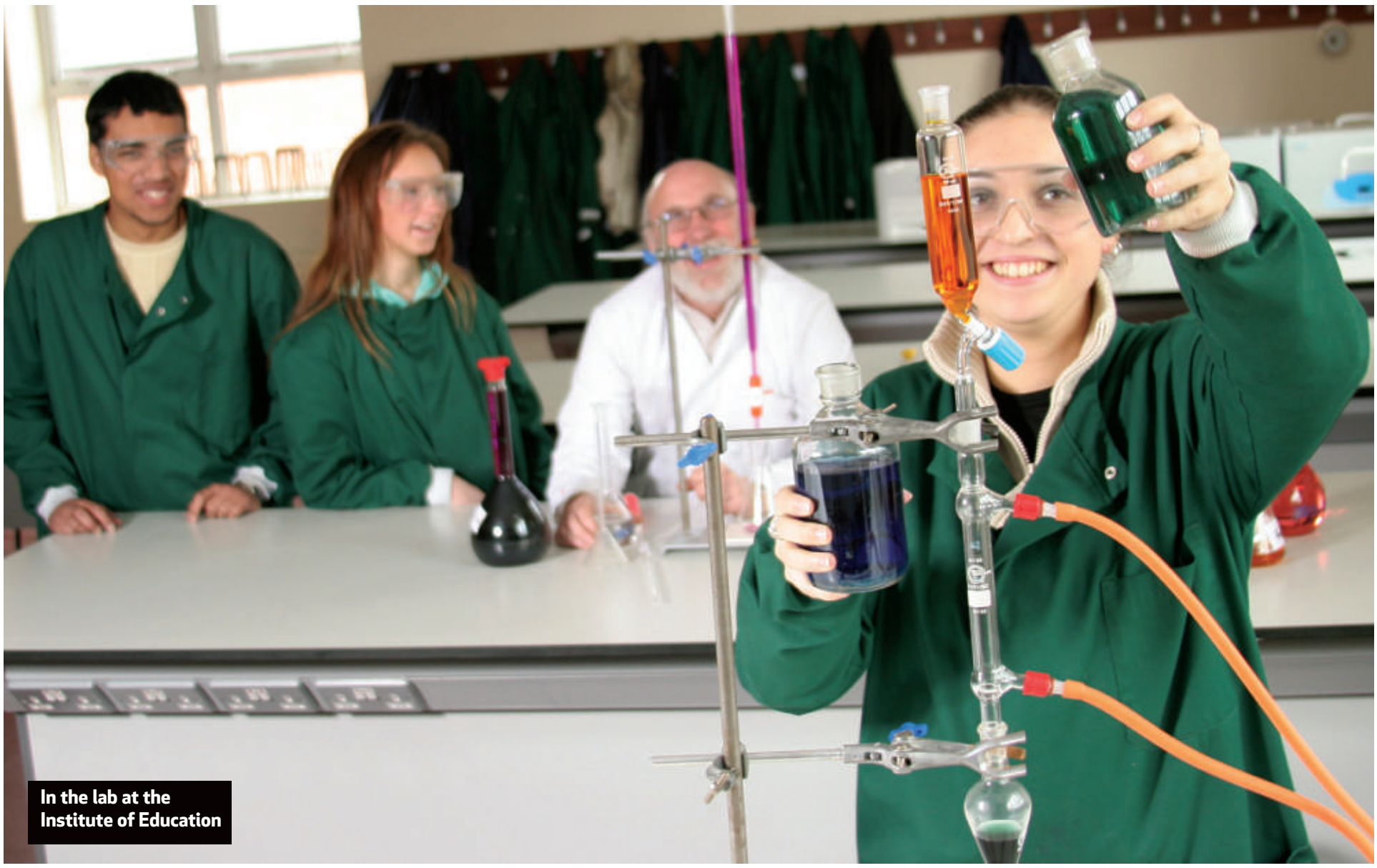
Irish Independent Institute of Education

exam brief

PART 4 * 27.02.2008

Science matters

28 pages of Leaving Cert Science



In the lab at the Institute of Education

Science is a vital part of our economy, with so many jobs in the chemical and pharmaceutical sectors. Our Science Exambrief gives you the complete guide to three vital science subjects for the Leaving Cert 2008 - **Physics, Chemistry and Biology**.

The students who did the Leaving Cert last year tell you how they achieved their grades in Physics, Chemistry and Biology - and still enjoyed the last year in school

The A1 Students * Dos and Don'ts * Tips from top Teachers

SCIENCES EXAMBRIEF

YOUR GUIDE TO THE LEAVING CERT 2008

WELCOME to Part 4 of our guide to the Leaving Cert in 2008. We began the series of supplements three weeks ago with a 28-page guide to the Maths exams. The following week we published a Languages Supplement covering English, Irish and French. Last Wednesday our Money Talks supplement covered Economics, Business and Accounting. Today's Science Matters supplement covers Physics, Chemistry and Biology. And the final Leaving Cert supplement next Wednesday will cover History, Geography and Home Economics.

The weekly ExamBrief supplements for Leaving Cert 2008 are being published by the Irish Independent in association with The Institute of Education. The five supplements in the Leaving Cert series will be followed by a sixth supplement for the Junior Cert on March 12th.

The Institute of Education is Ireland's leading private tuition college, sending more students to university than any other school over the past few years. Part of its success is attributed to the outstanding teacher notes supplied to its students.

These notes form the basis of this series of supplements. They provide an overview of the entire course in each subject with invaluable practical advice on how to study and how to maximise exam performance.

Last year the Institute was the No 1 provider of students to UCD, Trinity, the Royal College of Surgeons, DCU and DIT. Now with our ExamBrief series, all students can benefit from the notes and advice that have been so successful at the Institute.

The Leaving Cert ExamBrief supplements are available only with the Irish Independent and offer the only in-depth exam preparation guides available with an Irish newspaper. Unlike other supplements which have appeared, they cover the complete course in each subject.

This year our Leaving Cert ExamBrief series is even more extensive than in previous years. Subjects are being grouped thematically for the first time.

All supplements include a guide to the complete course in each subject, sample questions and answers, and advice from leading teachers plus advice from students who did well in last year's exams.

Supplements Editor: John Spain

Chemistry

TARA LYONS
Chemistry and Biology Teacher

Tara Lyons, B.Sc., H.Dip.Ed., has taught Higher Level Chemistry and Biology to Leaving Certificate level for twelve years. She has contributed to newspaper articles on the Chemistry and Biology papers for the Leaving Cert.

THE TEACHERS VIEW

The only way to ensure that you are well prepared for your chemistry exam is very simple – DO THE PAST EXAM QUESTIONS! Use the marking schemes from past years to check up on your key phrases and to correct your work. Reading a question and deciding that you can do it is simply fooling yourself. It is only when you put pen to paper that you really see how much you know or not. I cannot stress this enough.

When you enter the exam spend the first ten to fifteen minutes reading the WHOLE paper from start to finish and then choose eight questions based on ability to answer rather than on topics. For example, you may find a topic that you consider difficult to have a very straight forward question where-as an 'easier' topic may have a difficult question. It is a waste of time if you find half way through a question that it is not as you first thought.

Always examine the marks written after each part of a question. Most parts of the questions are marked in 'threes'. For example, if you see a part of a question is worth 9 marks then they are usually looking for at least three parts to your answer.

Definitions tend to be worth between 5 and 8 marks each and each question usually has at least one definition. I would generally expect definitions to be worth on average 15% of the overall grade (depending on question choice). Spend time on learning these properly.

TIMETABLE

Length of exam – 3 hours

Length of time per question – 22.5 minutes

Total number of questions – 11 questions

Number of questions to be answered – 8 questions

Total marks – 400 marks

Marks per question – 50 marks

SECTION A

In this section of the exam paper students are examined on their knowledge of the mandatory experiments on their course. Students are required to answer at least two questions out of three. Therefore this section is worth between 25% and 37.5% of the overall grade depending on whether a student answers two or three of the questions. This should indicate that this percentage of time should be given when studying these sections of the course.

QUESTION 1 – VOLUMETRIC ANALYSIS EXPERIMENT

There are eight titrations on the higher level course and two on the ordinary level course, ONE of these will be examined. Although each titration seems to be different from the others, on closer inspection you should find that the general procedures involved are the same. There are four common question types that should be prepared in advance.

1. Students will be asked to describe in detail the correct procedures in (i)weighing and preparing a solution in a volumetric flask, (ii) preparing and using a pipette, (iii) preparing and using a burette and (iv) preparing and using a conical flask. This is important in both higher and ordinary level.
2. There will also be questions regarding any observations made during these experiments i.e. the most common being any colour changes that occur during or at the end-point of a titration.
3. Each titration has questions that are unique to that particular experiment, for example in a potassium manganate (VII) and iron (II) titration why is sulfuric acid used in two separate stages of the experiment and in a vinegar experiment why is the vinegar diluted before carrying out the titration, so students should be aware of these questions for each titration and expect them to appear. Examine the questions that have appeared in recent years on each titration and make sure you know the correct answer – use the marking schemes online to check.
4. Finally, there will be a calculation to find the concentration of a solution in mol/l and grams/l. Students may then be asked to change this to %(w/v) or in some cases find the % water of crystallisation and 'x' in a formula. If a titration involving water i.e. hardness or dissolved oxygen, the student will be expected to express the concentration in parts per million (p.p.m.). A balanced chemical equation will be given in the question.

HIGHER LEVEL
2002 – Vinegar titration
2003 – Iron tablet titration
2004 –EDTA titration
2005 – Winkler titration
2006 – Acid/base water of crystallisation titration
2007 – Sodium thiosulfate and iodine

ORDINARY LEVEL
2002 – Hydrochloric acid +NaOH
2003 – Sodium carbonate prep.
2004 – Sodium carbonate + HCl
2005 –Hydrochloric acid + NaOH
2006 – Sodium carbonate + HCl
2007 – Hydrochloric acid +NaOH

As of yet students, in higher level, have not been asked about ammonium iron (II) sulfate and potassium manganate (VII) or how to determine the % (w/v) of sodium hypochlorite in a sample of bleach in higher level. It would be very foolish to concentrate on just these as repetition of an already examined experiment is also highly possible.
** in ordinary level paper the volumetric question is question 2 on the paper.*

TEST YOURSELF
1. Describe the procedure in preparing and using a burette for use in a titration.
2. In an experiment to determine the concentration of sodium hypochlorite in a sample of bleach explain why potassium iodide is present in excess.

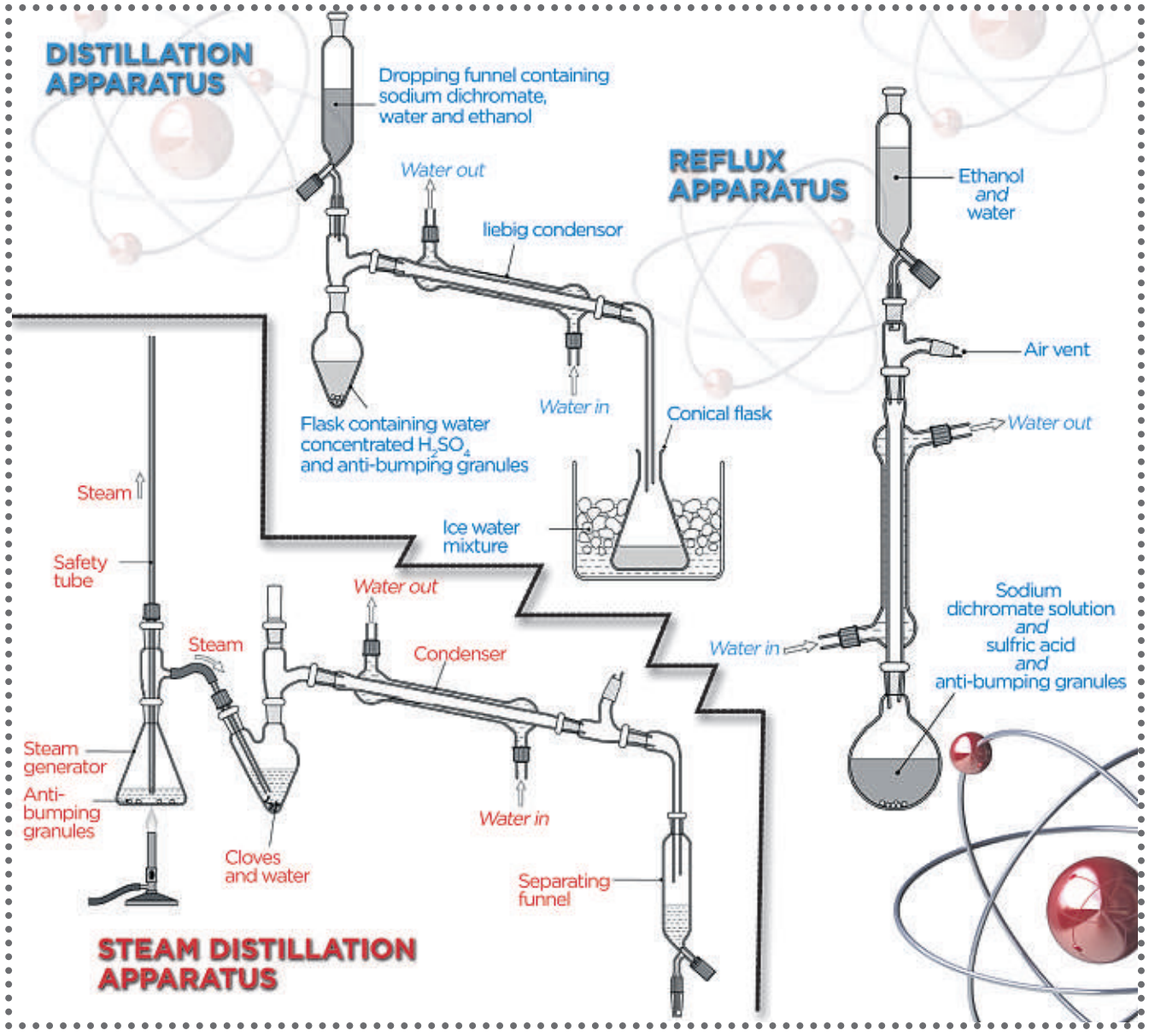
QUESTION 2 – ORGANIC CHEMISTRY EXPERIMENT

There are eight experiments on the higher level course and on the ordinary level. ONE of these will be examined in this section. The experiments can be divided into (a)preparations and (b)techniques. The preparations are of ethene, ethyne, ethanal, ethanoic acid and soap. The techniques are steam distillation with solvent extraction, chromatography (paper, TLC and column) and recrystallisation.

In this area of the course students are again examined in their **observations** during these experiments i.e. colour changes, effervescence, apparatus used and any **precautions** that should be taken during this experiment. **Diagrams** are extremely important. You may be given or have to draw and label the apparatus involved in each preparation or technique. Practise here is necessary as although you may be familiar with the apparatus, drawing it in exam conditions may prove more difficult. Here are some of the apparatus involved. You should try to draw a labelled diagram in about 5 minutes! **SEE RIGHT**

The student should be prepared for a **calculation** although this is not something that appears in this question every year. Typically a limiting reactant and percentage yield calculation may be appropriate.
** Organic chemistry experiment is question 1 on ordinary level paper.*

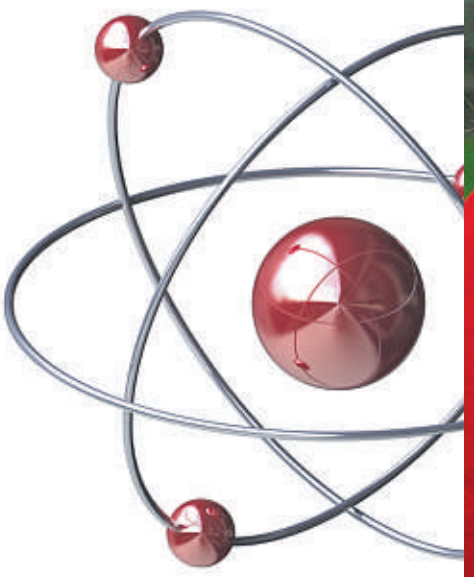
TEST YOURSELF
3. Write a balanced chemical equation to show the preparation of ethyne.
4. Give the name or formula of an impurity that may be present in the ethyne gas and identify the solid impurity from where it came.
5. Give the name of the aromatic compound found in clove oil. **CONTINUED ON PG6**



Higher level

The A1 Student's view

Name: Rosie Plunkett
Age: 18
From: Mount Merrion, Co. Dublin
School: Institute of Education
Year of Leaving Cert: June 2007
Points: 600
Results: Chemistry (H) A1, Biology (H) A1, English (H) A1, French (H) A1, History (H) A1, Home Economics (H) A1, Irish (H) A2, Maths (H) B2
Now studying: Medicine at Trinity College Dublin



Why Rosie had the right chemistry

To be honest, I'm not naturally scientific. All through fifth year I was getting Cs in chemistry tests with the occasional B if I really tried. I saw Chemistry as a more difficult subject than History or Biology because I thought it was somehow more abstract. Whenever I did sit down to study it (less often than I should have, I admit) I spent hours at it seemingly to no avail. I'd sit there reading over notes, highlighting, going to the textbook to read the material 'from a different angle' and writing my own notes on the chapter. I thought I was working pretty hard. Then when the test came around I would read a question and only vaguely remember the chapters I'd studied. For some reason the facts never seemed to stick in my head. I blamed Chemistry's enigmatic nature and firmly believed that only scientifically minded people did well in it.

It was in sixth year that I realised I was wrong. My teacher, Tara Lyons, was very matter of fact and told us that, essentially, Leaving Cert Chemistry is no different from any other Leaving Cert subject: it requires focused, active study. Reading over notes is useless, highlighting – which I used to do with great fervour – is useless, even copying out your teacher's notes is useless. You can spend all the time in the world at those things without ever actually retaining a single fact. The trick to Chemistry, and indeed most subjects, for the Leaving Cert is to spend your time learning the material rather than just studying it.

Instead of reading and rereading the chapter hoping for some of it to stick in your head, dive right in. One way to work is to write out the headings of the chapter you're doing on some scrap paper. Then fill in what you remember of each section from class. When you're finished, open the chapter and go through what you've written adding in extra points and noting what you got wrong. You don't need pages and pages of handwritten notes to prove you've worked hard that session. The important part is to be focused. Whatever you're doing in that session deserves your full attention, whether it's definitions (which should take up 10% of your study time since they usually make up 10% of the paper), or experiments, or the dreaded tests for anions. Learn it so you know it almost as well as your address. That way the stress of the exam won't throw you off.

Once you feel like you know the course well, in the final month or so before the exams, move on to final phase study. This is basically stamina training. Sit down with a past paper and a watch to do the paper in the allotted time. Then, after a well-deserved tea break, correct the paper using the marking schemes (available from www.examinations.ie) I'd really recommend printing them out and having a hard copy since they're arguably the best set of revision notes possible. Leaving Cert Chemistry is marked very precisely. If your answer isn't exactly what's accepted in the marking scheme, then it might as well be wrong. Correcting your own answers is a good way to gauge how well they fit the required template. It also gives you a chance to pick up on questions that tend to be asked regularly in certain sections. If you see a question being repeating over the years, it's a good idea to learn the official answer upside down and inside out.

Generally my advice for the Leaving Cert is to make the most of the time you spend studying. An hour or two of goal-directed learning is worth at least two to three hours of reading and highlighting. What matters is how much you know and how well you know it, not how many hours you spent at your desk. Work hard when you're working, and play hard when you're not.

Do your best and remember, in the words of Public Enemy: "don't believe the hype"

QUESTION 3 – EXPERIMENT QUESTION

In this question the student is examined in one of the remaining experiments on the course. In the past a second organic experiment has appeared here so be prepared for this also. If not another organic experiment then students need to be familiar with the remaining twelve experiments. Again the most important things to watch out for are (i) observations (ii) apparatus (iii) precautions and (iv) calculations if applicable.

HIGHER LEVEL

2002 – Effect of concentration on rate of reaction.
2003 – Determine relative molecular mass of a volatile liquid.
2004 – Recrystallisation.
2005 – Decomposition of hydrogen peroxide to determine rate of reaction.
2006 – Colorimetric experiment to estimate free chlorine in swimming pool water.
2007 – Heat of reaction between hydrochloric acid and sodium hydroxide.

ORDINARY LEVEL

2002 – Decompostion of hydrogen peroxide to determine rate of reaction.
2003 – Flame tests and test for sulfate ions in aqueous solution.
2004 – Heat of reaction between hydrochloric acid and sodium hydroxide.
2005 – Decomposition of hydrogen peroxide to determine rate of reaction.
2006 – Estimation of suspended and dissolved solids in a water sample.
2007 – Heat of reaction between hydrochloric acid and sodium hydroxide.

SECTION B

In this area of the paper students are given eight questions, three of which contain an internal choice (questions 4, 10 and 11). Either 5 or 6 questions must be answered in this section depending on the number answered in section A. Therefore section B is worth between 62.5% and 75% of the overall grade. Students need to choose the questions carefully by reading all questions before making a choice. This is extremely important as an incorrect choice can cost time later in the paper.

QUESTION 4 – SHORT QUESTIONS

In this question there are eleven short questions covering aspects of the entire course. The student is required to answer **eight** of these. Each question is worth 6 marks. It is important to remember that 'short' does not necessarily mean 'easy'. This is a common misconception among students and the necessary work is often not done in preparation for this popular question. If a student is planning on attempting this question in the exam in June, I strongly advise that sufficient time is given to this area by looking and physically doing all past question fours and also ones from the sample papers. It is only by giving the appropriate time that a good grade is achieved in this question. The chief examiners report in 2005 remarked that this question was the second most popular question but was 'poorly answered' and that 'candidates would benefit from practicing questions of this type'. This was true for both higher and ordinary level papers.

On examination of the past question fours in both levels, the student should notice the following: there are usually definitions, calculations, atomic theory and organic short questions and the final part is a question from the option part of the course.

TEST YOURSELF

6. State the shapes of the following molecules (i) hydrogen sulfide and (ii) phosphine.
7. Give the IUPAC name of CH_3CH_2COOH. Give a use for this compound.
8. Distinguish between a d-block and a transition element.
9. How many protons are present in 5.6g of iron, Fe?

QUESTION 5 – ATOMIC STRUCTURE

This question is quite popular with students every year in both higher and ordinary levels (especially ordinary level). This covers a large part of the course including the following topics: **bonding and electronegativity, atomic radii and ionisation energies, radioactivity, shapes of molecules and history of the periodic table and atom**. A thorough understanding of the tables at the back of the mathematics tables is necessary, especially discussing the trends in the electronegativity and ionisation energy tables and any exceptions to these trends.

Candidates are usually asked to define terms in this question and if vital points are lacking marks are lost. Students who give their own explanations tend to miss out on important words or key phrases. Definitions must be precise and this is only achieved when they are learned off by heart. This can not be stressed enough. A good exercise is to look at marks lost in mock exams in just definitions alone (in the whole paper) – students are often very surprised.

Ensure that all parts of the question are answered. If two elements are mentioned in the question then both elements should be referred to in the answer.

Students should be able to distinguish between all types of bonding on their course. In particular the difference between intramolecular and intermolecular bonding. For example both pure and polar covalent bonding are intramolecular as they occur between atoms in a molecule but hydrogen bonding, dipole-dipole and Van der Waals are examples of intermolecular bonding as these occur between two or more molecules. Students regularly show a lack of understanding here and mixing these up will cost all the marks for this part of the question.

Students at ordinary level try to guess answers in this question and score poorly.

TEST YOURSELF

10. Is the first ionisation energy always greater than the first ionisation energy? Explain.
11. Using electronegativity values predict the bonding present in ammonia. Then state the type of bonding present between ammonia molecules.
12. Distinguish between a sigma and a pi covalent bond.

QUESTION 6 – ORGANIC CHEMISTRY, FUELS AND THERMOCHEMISTRY

As this is the second organic chemistry question on the paper one should see that this section is of utmost importance. Students, at both higher and ordinary levels MUST be able to draw and name members of the eight homologous series on their course. This is the single most important aspect of this section. Failure to do this will lead to a poor grade as most of the time one or the other is needed to answer practically every organic question. Ensure that you can draw the functional group of each homologous series also. In the past students have been asked this and just drawn a complete molecule – marks were lost in this case. For example if asked to draw the functional group of alcohols the correct answer is –OH. If you draw a full molecule the student is not answering the question asked.

This question also tends to examine a students knowledge of the **reaction types** involved in organic chemistry. These include the following:

Substitution – Alkane and chlorine: $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$ (note 2 products)

Addition – Alkene and bromine: $C_2H_4 + Br_2 \rightarrow C_2H_4Br_2$ (note 1 product)

Elimination – Dehydration of ethanol to produce ethene: $C_2H_5OH \xrightarrow{Al_2O_3} C_2H_4 + H_2O$

Condensation – Alcohol and carboxylic $\rightleftharpoons$ acid ester and water:
$C_2H_5OH + CH_3COOH \rightleftharpoons CH_3COOC_2H_5 + H_2O$

Alcohols acting as acids – $C_2H_5OH + Na \rightarrow C_2H_5ONa + \frac{1}{2} H_2$

Oxidation of primary and secondary alcohols –

Propan-1-ol $\xrightarrow{H^+/Cr_2O_7^{2-}}$ propanal $\xrightarrow{H^+/Cr_2O_7^{2-}}$ propanoic acid

Propan-2-ol $\xrightarrow{H^+/Cr_2O_7^{2-}}$ propanone

Base hydrolysis of an ester – $CH_3COOCH_3 + NaOH \rightarrow CH_3OH + CH_3COONa$

Students sometimes are given a reaction scheme with parts that are missing. These parts tend to be reagents and/or conditions. For example:
Identify X in the following and give the term to describe this reaction type.
$C_2H_4 + X \rightarrow C_2H_5Cl$

ANSWER – X=HCl Reaction type = ionic addition reaction
A common mistake here is to give the reagent as either 'Cl' or 'Cl_2' . Both of these are incorrect as in the first instance Cl cannot exist monoatomically and if the latter were the reagent the product of the reaction would have to have two chlorine atoms in the structure (and it only has one). The reaction type here is obvious as C_2H_4 is an alkene and alkenes undergo addition reactions. Learn to associate reaction types with homologous series. For example alkanes undergo substitution reactions, alkenes addition reactions, alcohols can undergo elimination (dehydration), oxidation, condensation (esterification), and reacting as acids. Make sure you familiarise yourself with all reaction types.

There is usually an organic synthesis asked which involves two or three stages. An example of this would be as follows –
Write equations to show how ethene can be converted into ethanoic acid. Give the terms to describe these reaction types.

ANSWER – Stage 1. Ethene + water ethanol (primary alcohol)
$C_2H_4 + H_2O \rightarrow C_2H_5OH$

Reaction type – ionic addition reaction (hydration)

Stage 2. Ethanol in presence of acidified sodium dichromate is converted to ethanoic acid (using reflux apparatus)

$$C_2H_5OH \xrightarrow[Heat/Reflux]{H^+/Cr_2O_7^{2-}} CH_3COOH$$

Reaction type - Oxidation reaction

Solubility of each homologous series in polar solvents (water) and non-polar solvents (chloroform) is necessary. Remember the rule for solubility – 'like dissolves like'.

- Alkanes, alkenes and alkynes are all insoluble in polar water, as each of these homologous series is non-polar and therefore do not form hydrogen bonds with water.
- Alcohols have a polar –OH group, which leads to hydrogen bonding with water and therefore alcohols with short carbon chains, are soluble in water. As the non-polar carbon chain length increases the solubility in water decreases.
- Aldehydes, ketones, and esters, all possess a polar carbonyl group, (C=O) so again if the carbon chain part of the molecule is short then they are soluble in water as hydrogen bonds can form. As the carbon chain increases, they become more soluble in non-polar solvents such as chloroform (trichloromethane).
- Carboxylic acids possess both a carbonyl group and a hydroxyl group and are therefore able to form hydrogen bonds with water. However the non-polar carbon chain again influences solubility.

Boiling points and melting points – questions appear that ask students to compare the boiling points (or melting points) of different homologous series.

- Carboxylic acids have the highest boiling points due to hydrogen bonding between molecules and the formation of dimers.
- Alcohols have the next highest, due to hydrogen bonding between molecules.
- Aldehydes, ketones and esters all have weaker dipole-dipole attractions between their molecules hence lower boiling points than the other homologous series mentioned above.
- Alkanes, alkenes and alkynes have the lowest boiling points as they have the extremely weak Van der Waals forces between their molecules.

Remember the size of the molecule also influences the boiling point.

Students must be able to describe both the substitution **mechanism** for alkanes and the addition mechanism for alkenes. Substitution occurs in three stages (i) initiation – u.v light and homolytic fission (ii) propagation and (iii) termination. You must know the equations to illustrate these stages. Addition reactions can also be divided into stages – (i) polarisation of the bromine molecule by the double bond of the alkene, (ii) *heterolytic fission* of the bromine molecule, (iii) break of double bond and formation of carbonium ion and (iv) formation of final product. Again, students are required to use diagrams to illustrate each of these stages and give a brief description. The mechanism for ionic addition was examined in 2003 and 2006. The free radical substitution mechanism for alkanes was asked in 2007.

Distinguishing tests are important as they are usually asked every year.

- Bromine water will turn from red- brown to colourless with alkenes/alkynes but not alkanes as alkanes are saturated. Similarly dilute potassium manganate (VII) will change from purple to colourless in the presence of unsaturated compounds like alkenes and alkynes.
- Aldehydes are good reducing agents and therefore will change acidified potassium manganate (VII) from purple to colourless, Fehlings solution from blue to red precipitate and will cause a deposit of metallic silver with Tollens reagent. Ketones will not.
- Carboxylic acids will liberate carbon dioxide gas when reacted with sodium carbonate/ hydrogencarbonate.

Knowledge of the experiments is a must here also. These could make up some of the parts of the questions in this section.

This question can also examine the changes in temperature that occur during chemical reactions. In all of the types of reactions, combustion, formation, bond energy, the '1 mole' concept is very important. The student must be able to relate 1 mole of a substance to its molecular mass in grams, or 22.4 l at s.t.p. For example 1 mole of ethene, C_2H_4, is 28g or occupies a volume of 22.4 l at s.t.p. The definitions and laws are very important. You must be able to write equations to illustrate combustion and formation reactions. Remember, if writing an equation showing combustion, the substance is a reactant but in writing an equation showing formation then the substance is a product.

E.g. The equation to show the heat of combustion of ethene is
$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

The equation to show the heat of formation of ethene is
$2C + 2H_2 \rightarrow C_2H_4$

You may be then asked to perform simple calculations using the equations and Hess's Law to find the heat of reaction (ΔH) for a particular chemical reaction. This type of question is extremely popular and appears almost every year.

A thorough knowledge of the **bomb calorimeter** as an instrument to accurately measure heats of combustion must be learned and the use of the bomb calorimeter in determining calorific values of foods and of fuels along with kilogram calorific values in general.

It is important that a student can draw energy profile diagrams for exothermic and endothermic reactions and how the presence of a catalyst affects these diagrams.

The concept of bond energy values may be examined in this section; however the student is not required to know calculations.

Finally, you must be familiar with the experiment to measure the heat of reaction of an acid and a base and how to calculate the heat of reaction for this experiment (2007).

Organic chemistry can again pop up here in particular the section relating to hydrocarbons as fuels. Students must be familiar with the **fractional distillation of crude oil** and the names and uses of at least four of these fractions. The naphtha fraction is especially important as it from this that **petrol** is obtained. Students must be aware of the octane number of petrol and of methods of improving the octane number thus reducing the occurrence of auto-ignition ('knocking') i.e. adding lead in the form of tetraethyl lead, addition of oxygenates, isomerisation, cracking and reforming. Know which of these reduces pollution and how catalytic converters in cars also reduce pollution. The idea of crude oil and **natural gas** as fossil fuels may be examined. Be aware that Irish natural gas is 95% methane by comparison to natural gas from the U.S.A which is mainly propane and butane. Also know that 'mercaptans' are added to natural gas before distribution to give an odour for safety purposes.

TEST YOURSELF

13. State two structural features of a hydrocarbon molecule which contribute to it having a high octane number.

14. Write a balanced chemical equation to illustrate the formation of methyl ethanoate. Give the term to describe this esterification reaction.

15. Methane is a major component of natural gas. Why are mercaptans often added to natural gas? What environmental change or effect is associated with the release of methane to the atmosphere? Apart from leaking pipes, name a major source from which methane is released to the atmosphere.

QUESTIONS 7,8,9,10 AND 11.

The topics examined here can vary from year to year. Question 7,8, and 9 do not have any internal choice although some may have a couple of related sections appearing e.g. acids and bases with pH. Question 7 has in the past been another organic question. Questions 10 and 11 have three parts each (a), (b) and (c). These sections are totally unrelated to each other. Students are required to choose two of the three parts if answering these questions. Part (c) of question 11 examines the option part of the course.

We will now look at some of the topics that you may find in these questions.

Chemical equilibrium
The question usually involves:

- Definition(s)
- Application of Le Chatelier's Principle
- Calculation.

Application of Le Chatelier's Principle – there are **3 stresses** that you may be asked about. These are concentration, temperature and pressure.

If a substance is added equilibrium moves to the side that uses up that substance.
If a substance is removed equilibrium moves to the side that makes that substance.

If the temperature is increased, the endothermic reaction is favoured.
If the temperature is decreased, the exothermic reaction is favoured.

If the pressure is increased the reaction that produces the least number of moles is favoured.
If the pressure is decreased the reaction that produces the least number of moles is favoured.

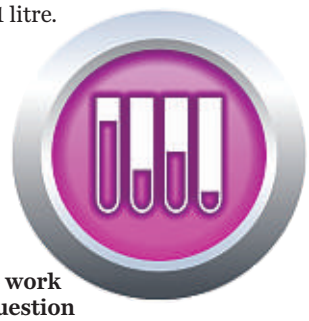
Students are usually asked to write the equilibrium constant expression for a particular reaction.
Write the equilibrium constant expression, Kc, for the following reaction:
$N_2 + 3H_2 \quad 2NH_3$

ANSWER - $Kc = \dfrac{[NH_3]^2}{[N_2][H_2]^3}$

As we can see the products are on top of the expression and the reactants on the bottom. The square brackets mean mol/l and each substance is put ' to the power of' the number of moles in the balanced equation.

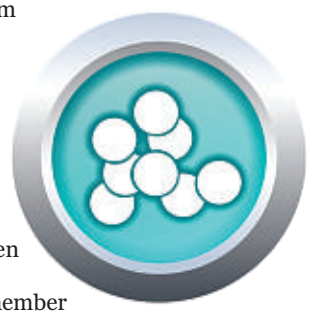
There are **two main types of calculations** involving Kc.
When you are asked to **calculate Kc** (**2002 and 2004**).

(a) Convert grams to moles by dividing by the molecular mass if necessary.
(b) If given the volume of the system convert to moles per 1 litre. (If volume is not given it doesn't matter as all units will cancel as there will be equal numbers of moles on both sides of the equation.)
(c) Fill into table the initial moles of reactants and the moles of the substance given in the question at equilibrium. (Remember there will never be any moles of product initially as the reaction has not started yet!).
(d) Work out the change for the substance you have most information about.
(e) N.B. Use the molar ratio in the balanced equation to work out the change in the rest of the substances in the question N.B.
(f) Substitute the values at equilibrium into the equilibrium constant expression to calculate Kc at the given temperature.



When you are given Kc and asked to calculate the moles (orgrams) of the substances given in the equation at equilibrium. (2003 and 2005)

(a) Convert grams to moles by dividing by the molecular mass if necessary.
(b) If given the volume change to moles per litre, if not given do not do anything.
(c) Fill into the table the initial moles of reactants and remember there will be no product initially.
(d) Use the molar ratio from the balanced equation and x for the change.
(e) Combine together to get moles at equilibrium (these values will be expressed with x).
(f) Substitute these final values into the equilibrium constant expression, Kc, using the value given in the question for Kc.



(g) Work down to a quadratic equation i.e. $ax^2 + bx + c = 0$ and solve for using the formula

$$x = \frac{-b \pm \sqrt{b2 - 4ac}}{2a}$$

(h) You will get two answers for x, one will be inappropriate (bigger than the values used initially), ignore this value and use the other value for x to answer the questions involved.

**calculations not required at ordinary level. Students are expected to write the expression for Kc.*

TEST YOURSELF

16. When an experiment, using 1.5 moles of hydrogen and 1.5 moles of iodine, was carried out at 623K, it was found that the value of **Kc** was **64**. Calculate (a) the number of moles, (b) the mass, of iodine present in the equilibrium mixture at this temperature.

Stoichiometry – the mole forms the basis of most of the calculations in chemistry. You must be able to express amounts of substances in moles or it's equivalent in varying units.
1 mole = molar mass
1 mole = 22.4l at s.t.p.
1 mole = 6×10^{23} particles
Many of the calculations involve converting one quantity to another so it is important that you practice this.

Example –
1 mole of CO_2 = 44g = 22.4 l = 6×10^{23} molecules = $3 \times 6 \times 10^{23}$ atoms.
0.25 moles of CO_2 = 11g = 5.6 l = 1.5×10^{23} molecules = 4.5×10^{23} atoms.
A balanced chemical equation represents molar quantities and the amounts of reactants and products involved are in proportion.
For example if we examine the following equation we can see the molar ratio as follows:

$2NaHCO_3 \rightarrow CO_2 + Na_2CO_3 + H_2O$
2 moles 1 mole 1 mole 1mole

If 1g of sodium hydrogen carbonate is used, what mass of sodium carbonate is produced?
1 mole of $NaHCO_3 = 23 + 1 + 12 + 3(16) = 84$

$\frac{1g}{84}$ = 0.0119 moles

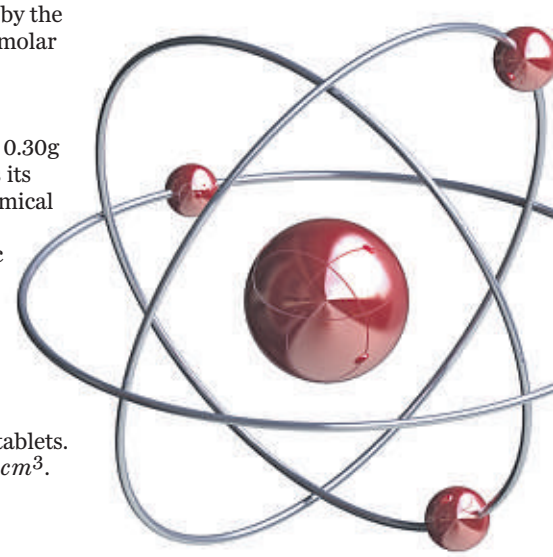
From the balanced equation $2NaHCO_3 \rightarrow 1Na_2CO_3$

Therefore 0.0119 $\rightarrow \frac{0.0119}{2}$ moles = 0.00595 moles
Moles x M_r (Na_2CO_3) = grams
0.00595 x 106 = 0.6307g of sodium carbonate produced.

Empirical and molecular formulae style questions should be practised, as they are popular.

In 2005 the following question appeared –
When 3.175g of copper reacts with chlorine gas 6.725g of copper chloride is formed. Find by calculation the empirical formula of the chloride.
Solution –
Cu =3.175g ÷ 63.5 = 0.05moles; Cl=(6.725g-3.175g) ÷ 35.5=0.1moles
ratio Cu:Cl=0.05:01=1:2 hence $CuCl_2$

Watch out for calculations where one of the reactants is in excess. You may be asked to prove this. Remember the other reactant will then be the limiting reactant and the amounts of products formed is determined by the limiting reactant so use this value with the molar ratio to work out the rest of the problem.



TEST YOURSELF

17. An indigestion tablet contains a mass of 0.30g of magnesium hydroxide [$Mg(OH)_2$] as its only basic ingredient. The balanced chemical equation for the reaction between magnesium hydroxide and hydrochloric acid ($HCL_{(aq)}$), the acid produced in the stomach, is as follows:

$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

(i) Calculate the volume of 1.0M HCl neutralised by two of these indigestion tablets. Give your answer correct to the nearest cm^3.
(ii) What mass of salt is formed in this neutralisation?

ENVIRONMENTAL CHEMISTRY – WATER

Definitions – hard water, temporary hardness, permanent hardness, eutrophication, Biochemical Oxygen Demand.

Students should have a thorough knowledge of the ions that cause 'hardness' in water, (Mg^{2+} /Ca^{2+}), the compounds that cause both temporary and permanent hardness and varying methods of removing individual types of hardness i.e. boiling and ion exchange.

Experiments -

- Determine the total hardness in a water sample using EDTA-titration (2004)
- Estimation of dissolved oxygen using the Winkler method- titration (2005)
- Determining the suspended (by filtration) and dissolved solids(by evaporation) in a water sample. (2006)
- Determining the amount of 'free chlorine' in swimming pool water(2006).

The steps involved in the treatment of water for drinking and sewage treatment must be learned. Make sure that you know the reason for each step in each of these treatments as they are often examined (2005).

Pollution of water caused by uncontrolled use of nitrate fertilisers leading to eutrophication and by the presence of heavy metal ions such as Pb^{2+}, Hg^{2+} and may also appear in this question. Learn the sources of heavy metal pollution and methods of removing these metals from water by precipitation.

The instrumental methods used in water analysis such as pH meter, AAS and colorimetry and the principles of each of these methods should be learned.

Finally you are required to know how the B.O.D. of a water sample can be achieved.

TEST YOURSELF

18. Name the ions mainly responsible for hardness in water.
19. Write an equation to show that temporary hardness can be removed by boiling.
20. Distinguish between suspended and dissolved solids.

There are three experiments showing how particle size, concentration and temperature affect the rate of a reaction. The key to these is determining the **number of effective collisions**. A question examining one of these experiments usually appears each year.

RATES OF REACTION

Definitions – rate of reaction, catalyst, activation energy, homogenous catalyst, heterogeneous catalyst, autocatalyst, enzyme.

- The larger the particles size, the smaller the surface area, hence a decrease in rate.
- The higher the concentration of a solution, the more frequently effective collisions occur, hence an increase in rate.
- The higher the temperature, the greater the kinetic energy of the molecules, hence the faster the rate.

Remember a small rise in temperature can lead to a huge increase in the reaction rate as the rate of a reaction is dependant on the proportion of molecules that contain activation energy. A small rise in temperature can cause this.

You are likely to be asked either to draw a graph (2005 and 2002) or interpret a graph in this section. Make sure that if asked to 'use your graph' that the answers come from referring to your graph as marks are lost otherwise. Make sure that you can calculate both the **average rate and the instantaneous rate** at a particular time (2005).

Catalysts and their properties and the explanations of homogenous, heterogeneous and autocatalysts can be asked along with the adsorption and intermediate compound theories. Students must also be familiar with energy profile diagrams of exothermic and endothermic reactions and the effect that the presence of catalysts will have on these diagrams (2004).

You also could be asked questions with reference to industrial processes and the catalysts that are used in these processes i.e. Haber process- iron catalyst, Contact process- vanadium (V) oxide etc.

TEST YOURSELF

21. Hydrogen peroxide decomposes rapidly in the presence of a manganese (IV) oxide catalyst. A student has a choice to using the same mass of finely powdered manganese (IV) oxide or coarsely powdered (granulated) manganese (IV) oxide. Which of these would you expect to have a greater rate of reaction over the first minute of the reaction? Give a reason for your answer.

ACIDS, BASES, PH AND INDICATORS

Definitions – acid, base, pH, amphoteric, conjugate pair, ionic product of water, indicator.

Two different theories of acids and bases must be studied i.e. Arrhenius and Bronsted-Lowry although the latter is the one that is most often examined. Be able to differentiate between these theories.

If given an equation you must be able to identify the Bronsted-Lowry acid and base and to pick out the conjugate pairs (two substances that differ by one H^+). This is an extremely common type of question. For example:

H_2SO_4 $+H_2F_2$ $\rightarrow H_2SO_4^+$ $+HF_2^-$
base acid conjugate acid conjugate base

Students must understand the difference between a strong and weak acid/base and calculate the pH of various strengths of acids and bases. When calculating pH's, watch out for units – they must be in mol/l .

Question – Calculate the pH of a solution containing 0.049 grams of sulfuric acid in 200 cm^3 of solution.

Solution –
0.049g =200cm^3
x =1000cm^3(1litre)
x =0.254g

Mr of H_2SO_4 = (1)+32+4(16)=98

$\frac{0.245g}{98}$ =0.0025 0.005mol/l

$H_2SO_4 \rightarrow 2H^+SO_4^{2-}$ (Molar ratio of acid to hydrogen ion concentration is 1:2)
0.0025 $\rightarrow$ 0.005

$pH = -\log[H^+]$
$pH = -\log[0.005]$
$pH = 2.301$

How indicators function using Le Chatelier's Principle should be learned along with how to choose an indicator for a particular type of titration.

Students should also practise writing balanced equations involving the following:
Acid +Metal $\rightarrow$Salt +H_2
Acid +metal oxide/hydroxide $\rightarrow$Salt +H_2O
Acid +Metal carbonate/hydrogencarbonate $\rightarrow$Salt +H_2O+CO_2

TEST YOURSELF

22. What are the limitations of the pH scale?
23. Identify the acid, and conjugate acid in the following system.
H_2S $+O^{2-}$ $+OH^-$ $+SH^-$

OXIDATION AND REDUCTION

Definitions – oxidation, reduction, oxidation number, redox reaction

The two ways of defining oxidation and reduction must be learned i.e. in terms of electrons and in terms of oxidation number and students should read the question carefully to ensure that they give the correct one.

In terms of electrons – oxidation is the loss of electrons, reduction is the gain of electrons.

In terms of oxidation number – oxidation is an increase in oxidation number and reduction is a decrease in oxidation number.

Almost every question that appears on this topic involves working out oxidation numbers of elements. To do this students must LEARN the eight rules that apply when assigning oxidation numbers otherwise attempting this question is a waste of time.

Remember that oxygen has three oxidation states. It is usually –2. However when bonded to fluorine it is +2 as fluorine is more electronegative than oxygen and it is –1 when it is a peroxide (O_2^{2-}).

Hydrogen usually has an oxidation number of +1, except when in a hydride when it is –1 due to the fact that hydrogen is the more electronegative element of the two elements in a hydride.

Finally, students must know how to balance equations using oxidation numbers so practice these to ensure that you are familiar with the steps involved.

TEST YOURSELF

24. Using oxidation numbers or otherwise, identify the reducing agent in the reaction between acidified potassium manganate (VII) and potassium iodide solutions represented by the balanced equation below. Use your knowledge of the colours of the reactants and products to predict the colour change you would expect to see if you carried out this reaction (9)

$MnO_4^- + 10I^- + 16H^+ \rightarrow 2Mn^{2-} 5I_2 + 8H_2O$

THE GAS LAWS

Definitions – Boyle's law, Charles law, equation of state for an ideal gas, Gay-Lussac's law.

Students are required to have an understanding of Boyle's, Charles and Gay-Lussac's laws, however calculations are not required for these. The equation of state for an ideal gas and why and how real gases deviate from ideal behaviour are commonly asked. When using PV=nRT, remember that you must use S.I units (Pa,cm^3, K). You may also be asked to carry out calculations using the general gas law including correction of gas volumes to s.t.p. (Pa, cm^3, K).

The experiment to measure the relative molecular mass of a volatile liquid using a gas syringe or an alternative method is important. You may be asked to draw the diagram of the apparatus used and to describe how the mass and the volume of the vapour is measured. The mass of the volatile liquid can be solved using the ideal gas equation but remember again to use S.I. units. (**2003, higher level**)

TEST YOURSELF

25. Why do ideal gases not exist?

ANSWERS TO TEST YOURSELF QUESTIONS

1. Rinse with deionised water, rinse with solution it is to contain, clamp vertically, remove funnel when bottom of meniscus is on the graduation mark and ensure the bit below the tap is full.

2. Potassium iodide is in excess to ensure that the oxidising agent, sodium hypochlorite, is the limiting reactant i.e. all the sodium hypochlorite has reacted.

3. $CaC_2 + 2H_2O \rightarrow C_2H_2 + Ca(OH)_2$

4. Phosphine, (PH_3) from calcium phosphide / hydrogen sulfide, (H_2S) from calcium sulfide.

5. Eugenol.

6. (i) V shaped (ii) pyramidal.

7. Propanoic acid. Used as a food preservative.

8. A d-block element is one whose highest energy electron enters a d orbital. A transition element forms at least one ion with a partially filled d sublevel.

9. $\frac{5.6g}{56} = 0.1mol \times 6 \times 10^{23}\ atoms \times 26\ protons = 1.56 \times 10^{24}\ protons$

10. Yes. The first electron is removed from an atom the second electron is removed from an ion, although the nuclear charge has not changed the influence the nuclear charge has on the lesser number of electrons in an ion is greater, hence more energy needed.

11. Bonding in ammonia is polar covalent as the electronegativity difference between nitrogen and hydrogen is less than 1.7 but greater than 0.4. the type of bonding between ammonia molecules is hydrogen bonding.

12. Sigma bonding is 'head-on' overlap of orbitals, pi is 'sideways' overlap of p orbitals.

13. Short chained, highly branched and aromatic.

14. $CH_2OH + CH_3COOH \rightleftharpoons CH_3COOCH_3 + H_2O$ Term = condensation reaction.

15. Natural gas is odourless so mercaptans give it a smell for safety. Greenhouse effect. Digestive systems of cows and sheep, paddy fields, slurry pits.

16.

	H_2	I_2	$2HI$
Initial	**1.5**	**1.5**	**0**
Change	$-x$	$-x$	$+2x$
At equilibrium	$1.5-x$	$1.5-x$	$2x$

Kc = 64 @ 623K

$$\frac{64}{1} = \frac{[2x]^2}{[1.5-x][1.5-x]}$$

$4x^2 = 64(2.25 - 3x + x^2)$

$4x^2 = 144 - 192x + 64x^2$

$4x^2 = -64x + 192x - 144 = 0$

$-60x + 192x - 144 = 0$

$$x = \frac{-192 \pm \sqrt{(-192)^2 - 4(-60)(-144)}}{2(-60)}$$

$$x = \frac{-192 \pm \sqrt{36864 - 34560}}{-120(-60)}$$

$$x = \frac{-192 \pm 48}{-120}$$

$$x = \frac{-192+48}{-120} \qquad x = \frac{-192-48}{-120}$$

$x = 1.2$ $\qquad$ $x = 2$(too large)

(a) Moles of iodine = 1.5 – 1.2 = 0.3 moles

(b) No. of moles X Mr (I_2) = grams

Grams of iodine = grams of iodine

17. (i) $2 tablets \times 0.3g = 0.6g \div 58 = 0.0103 mol$

$0.0103 mol\ Mg(OH)_2 \equiv 0.0206 mol$ Hcl

$$\frac{V \times M}{1000} = moles$$

$$\frac{V \times 1.0M}{1000} = 0.0206 moles$$

$V = 20.6cm^3 = 21cm^3$

(ii) $0.0103 mol\ Mg(OH)_2 \equiv 0.0103 mol\ MgCl_2 \times 95 = 0.95g$

18. Calcium and magnesium ions.

19. $Ca(HCO_3)_2 \xrightarrow{heat} CaCO_3(\downarrow) + H_2O + CO_2$

20. Suspended solids are insoluble substances found floating in or on the water and can be removed by filtration of the water whereas dissolved solids are soluble substances in the water and can be found by evaporating off the water.

21. Finely powdered as there is greater surface area for the reaction to happen.

22. Does not work in concentrated solutions/ aqueous solutions/ 25° C/0-14.

23. Acid = H_2S conjugate acid = SH^-

24. Reducing agent is I^- as its oxidation number increases from -1 to 0. The colour change would be purple (MnO_4^-) to red/brown (I_2).

25. (i) There are attractive forces between gaseous molecules and (ii) the amount of space gaseous molecules occupy is significant especially under high pressure.

OPTIONS

In this section of the course higher level students choose between Option 1(A and B) and Option 2(A and B) in their entirety, however ordinary level students choose ONE from options 1A, 1B, 2A and 2B.

Option 1A – this deals with additional industrial chemistry. Students are recommended to visit a chemical plant and see how the characteristics of effective and successful industrial chemical processes are present in that plant. Students are required to know the difference between batch, continuous, and semi-continuous industrial chemical processes. A case study on one of the following processes should be studied:

Manufacture of ammonia

Manufacture of nitric acid

Manufacture of magnesium oxide

Option 1B – this deals with atmospheric chemistry. Students are required to study oxygen, nitrogen, carbon dioxide, atmospheric pollution and the ozone layer.

Option 2A – this deals with materials. Students must learn about different types of crystals, addition polymers and metals.

Option 2B – this deals with additional electrochemistry and the extraction of metals.

Biology

JOE REVILLE
Biology Teacher

Joe Reville was educated at Synge Street C.B.S. and U.C.D. He taught Science and Biology in South Australia in 1973, and in 1974 worked for the CSIRO in the Northern Territory studying the ecology and physiology of "native" rats. He has been teaching Science and Biology in Ireland since 1976. He has had several books published; Science: Rapid Revision Science and This Is Science; Biology: Rapid Revision Biology and Biology Workbook; and Study Skills: Yes You Can!

THE TEACHERS VIEW

This Biology Exam Brief deals with Ordinary and Higher Biology. The ordinary and higher levels have the same examination structure and great similarity of questions – indeed the ordinary level questions are great practice for higher level students plus many of the questions in the higher past papers are suitable for ordinary level. The major difference between the two levels is the detail required in the answers.

Let us start with good news. Students taking the higher level paper - less than 10% of you will score less than a D grade – the success rate is very good so this should take much of the fear out of the exam. At least two thirds of you will achieve a C grade or better. An A grade will be achieved by 10% to 15% of you. You should be feeling very confident about the biology exam. It is definitely worthwhile making a good effort at study as it will be richly rewarded.

There are problems at ordinary level – some of the questions on last year's exam paper were more suited to higher level. The compensation is that the marking scheme is extremely 'student friendly'. A good preparation is to know your old Junior Cert biology really well.

You must make sure you are familiar with the style of the exam paper. Your 'past papers' and 'mock exam' will alert you to this. Did you spot a major shortcut to 'success in leaving cert biology'?

If you haven't started studying yet, you belong to a large club. The sooner you start the less likely you are to be disappointed. Those of you well started keep at it to maintain your huge advantage. Reliance on tips is gambling. You only hear of the few 'success stories' never the woes of the many disappointed. Do the work – it is far more reliable.

Keep Mum happy! It is usually mothers who suffer the most during the exam. Lie if you have to – it is essential to convince her that you have done well each day and so she will be in good humour and take care of you. Don't worry about results day – you will probably be in the Canaries well away from her anger!

Best of luck. Joe Reville

exam brief

BIOLOGY EXAM PAPER: FORMAT AND TIMETABLE

TIME 3 HOURS OR 180 MINUTES
MARKS 400

STRUCTURE SECTION A (100 MARKS OR 25% OF EXAM)

SIX STRUCTURED 'SHORT-ANSWER' MULTIPART FILL-IN QUESTIONS
2 questions from Unit 1 of the Syllabus
2 questions from Unit 2 of the Syllabus
2 questions from Unit 3 of the Syllabus
Each question with several small questions that must be answered in the spaces provided on the exam paper. You are instructed to answer any **five** questions.

ANSWER ALL SIX QUESTIONS: Sometimes it is best not to do what you are asked! Golden Rule: No blank spaces – answer everything.Do not rewrite the question in your answer – often only a word, never more than a short sentence is needed for an answer. Each question carries 20 marks.Marks are awarded for your five best scoring questions.

MAXIMUM TIME: 35 minutes.

STRUCTURE SECTION B (60 MARKS OR 15% OF EXAM)

Three structured multipart fill-in questions based on the 23 mandatory practical activities (MPAs) at higher level and 22 at ordinary level.
ANSWERS MUST BE WRITTEN INTO THE SPACES

PROVIDED ON THE EXAM PAPER. You are instructed to answer any two questions.
Answer all three questions. Golden Rule: No blank spaces.
Each question carries 30 marks.
Marks will be awarded for your two best scoring questions.

MAXIMUM TIME: 25 minutes.

STRUCTURE SECTION C (240 MARKS OR 60% OF EXAM)

THIS SECTION CONTAINS SIX 'LONG-ANSWER QUESTIONS'.
One question from Unit 1 of the Syllabus.
Two questions from Unit 2 of the Syllabus.
Three questions from Unit 3 of the Syllabus.

ANSWERS MUST BE WRITTEN IN THE ANSWER BOOK.
You are instructed to answer any four questions.

ANSWER FOUR QUESTIONS: Each question carries 60 marks.

MAXIMUM TIME: 2 hours (120 minutes i.e. 30 minutes per question).
You may answer more than four questions.Only do so if you have the time.
Marks will be awarded for your four best scoring questions in Section C.

TIMING WITHIN SECTION C QUESTIONS
It is very easy to give too much time to a subsection of a Section C question. You must allocate you time according to the marks. This is easy to do for two reasons.

First, there are 60 marks per question for you to complete in 30 minutes – so it should take a minute to gain two marks.

Second, questions 10, 11, 12 and 13 are divided into three parts and the three units of marks must be 9, 24 and 27. The 9-mark subsection should not take more than 4 minutes, the 24 mark subsection not more than 12 minutes and the 27 mark subsection not more than 13 minutes.

GENERAL ADVICE

NEVER LEAVE THE EXAM CENTRE EARLY

If you have completed four questions in Section C and there is time left over then do another question – try very hard to get this question done in the remaining time as only tackling part of the question leaves you well short of the potential to score full marks.

If you are going to make the examiner 'work harder' by marking extra questions then make their work easier by making your work neat, tidy, well organised and easy to mark.

THE MAJOR SHORTCUT TO SUCCESS IN LEAVING CERTIFICATE BIOLOGY
Maximum result for minimum effort – that is our aim? Know it all in Unit 1 and Unit 2 of the Syllabus and the Mandatory Practical Activities (MPAs).

Units 1 and 2 plus the MPAs make up just over 40% of the syllabus and are worth at least 80% of the marks and maybe more than 90%.

Units 1 and 2 are quite short and there is only a relatively small number of questions that can be asked from these to fit in with the format of the exam paper.

WHAT ABOUT UNIT 3?
This is your bonus for more points. Unit 3 will supply you with at least one scoring question in Section A – 20 marks. And will also add at least one extra scoring question in Section C – 60 marks. Nine out of every ten students will score at least 10% on these i.e. 8 marks (2% of the exam) .

But two thirds will score an extra 52 (13% overall) on these 'bonus questions' as two thirds of each question must be 'nice' for two thirds of those sitting the exam.

So your study of Unit C must at minimum be on the areas that you find easy and/or interesting for this is the material needed to get two thirds of the students a C grade or better.

MAJOR TOPICS IN THE UNITS 1 AND 2 OF THE BIOLOGY SYLLABUS

UNIT 1: THE STUDY OF LIFE
1. The Scientific Method
2. The Characteristics of Life
3. Nutrition or food biochemistry.
4. General Principles of Ecology.
5. A Practical Study of an Ecosystem
6. Human Impact on the Biosphere.

UNIT 2: THE CELL
Cell Structure: light microscope and electron microscope studies.
Cell Metabolism: enzymes, photosynthesis, respiration, diffusion and osmosis.
Cell Continuity: chromosomes, mitosis, meiosis and cell cycle.
Cell Diversity: plant and animal tissues, organs and organ systems.
Genetics: DNA, RNA, protein synthesis, genetic engineering, genetic crosses, evolution.

UNIT 3: THE ORGANISM
Diversity of Organisms: classification, bacteria, fungi, Amoeba.
Plant Organisation: flowering plant structure – external and internal.
Transport: human blood and lymphatic systems, water and food transport in plants.
Gas Exchange: human breathing system, stomata and lenticels in plants.
Excretion: kidneys, lungs, skin and liver.
Nutrition: types of nutrition and human digestive system, food storage organs in plants.
Responses to Stimuli: plant growth regulators, human nervous system including sense organs, endocrine (hormonal) system, musculo-skeletal system and immunity.
Reproduction: flowering plant reproduction – vegetative and sexual, human sexual reproduction.

Higher level

The A1 Student's view

Name: Niall Nelligan
From: Leopardstown
School: Institute of Education
Course: Medicine
University: University College Dublin (UCD)
LC results: 600pts:
Biology – A1
Physics – A1
Chemistry – A1
Maths – A1
Applied Maths – A1
Agricultural Science – A1

A winning study regime for biology

Biology is probably the most popular science subject taken by students in the leaving certificate. Many students believe that it is the 'easiest' science; however I must disagree on the basis that a subject is only 'easy' if a student is willing to learn the required material and revise it enough that the information can be recalled instantaneously in both stressful and relaxed situations. Having a teacher who can relay the information in a concise and stimulating way is a major benefit, like my teacher Michael O'Callaghan at the Institute of Education.

Biology has one of the largest syllabi of all the Leaving Certificate subjects; however I would argue it has the most interesting material - with topics ranging from learning about interactions between organisms in Ecology to learning about the physiological systems in the body. The material I learnt in leaving cert biology still helps enormously with material I am currently covering in Medicine in UCD. Clearly then the level of work that a student puts into the study of Biology can directly impact on future success in their University course.

Despite the sometimes daunting workload that Biology presents, I found that certain key approaches and ideas helped me to get the A1 in Biology (and indeed in some of my other subjects too). My study regime was more about consistency and quality than quantity. I was never one of the "I did 20 hours study over the weekend" people but I would put in a solid effort everyday. From around February onwards, every Sunday I would set out a plan for the material I wanted to cover in the upcoming week. I always planned around a six day schedule so that if I didn't get my plan finished in 6 days I had the 7th day as catch up. And if I did get the plan completed early I would know that I could increase the workload for the following week.

I studied biology 4 times a week and allotted 1½ hrs to a sitting. After each sitting I would close my book/notes and try make up a summary in my head of the material I had just studied. Subsequent to that I would read the summary provided in the book. I used to find this a priceless way of checking to see could I recall the information. An approach I found most useful was doing topics that were related. For example I would learn about the heart, blood vessels and the lymphatic system together as they are interrelated. I found that this helped in understanding and retaining the information better compared to if I'd learnt the blood vessels and plant reproduction in the same session.

The homework and regular class tests set by Mr. O'Callaghan were a great feedback to progress. My approach to each class test was that each one was the actual leaving certificate exam. I became so accustomed to dealing with the pressure that when the time came for the real exam I didn't feel phased by the situation. Also, the regular use of the past papers to practice exam questions added to my preparation for the 'big day' enormously.

I used to use the divisions/sections in Michael O'Callaghan's Biology book, (Leaving Certificate Biology) as my study guide since they are based on the syllabus. There are three 'areas' to the course and questions from each division must be present. I made sure I knew the first six chapters (scientific method, ecology, food & nutrition) exceptionally well since they are considered one of three areas on the LC Biology course. By knowing these chapters well a student has a strong chance of getting at least 1 set of short answer questions in Section A of the exam and at least 1 ½ questions between section B and C. It's a lot of return for the amount of work required.

Two topics a student should know extremely well are 'Photosynthesis' and 'Respiration' as they are topics that feature on the exam every year. Mr. O'Callaghan discussed these topics at length with emphasis on diagrams to remember the detail. Learning one diagram with all the information present in shorthand or picture form can save hours of learning and I often found helped in the understanding of a topic. As to the long questions on the paper I always answered them in a bullet point approach. This cut down on the amount of waffle I wrote - something an examiner appreciates and may benefit you if you are a borderline case for a grade.

In the last couple of months before the leaving certificate began I did notice an increase in the amount and intensity of work. However, I made sure never to go to the point of complete exhaustion in a study session which meant I was able to tackle classes and study effectively the next day. For the days that I did feel drained or disillusioned I always thought of my motivation for doing all the work – for me there was no stronger motivation than the chance to study medicine. I'm a firm believer that everyone has something that they can use to motivate themselves to focus when they are disillusioned, finding what that is and using it is something that will remove many of the barriers on the way to success.

Finally, we often forget the support network that we have behind us. I made some great new friends in the institute last year who along with my family and established friends provided a great source of encouragement and inspiration for which I am eternally grateful. I believe students should remember that they are not alone during the tough times or indeed the highlights of this year.

So now all that remains to say is put your best effort into each exam and best of luck class of 2008.

Higher level

The Student's view

Name: Eoin Cashman
School: St. Josephs College "The Bish", Nun's Island, Galway
Results: 525 points in Leaving Cert 2007 - Irish A1, English B1, French A2, Physics B3, Biology A2, Technical Drawing B1
College: Now in First year psychology at NUI, Galway

Holding on to your sanity

I found the biggest help in staying calm about the Leaving Crcert. was in keeping up my hobbies. They acted as a great stress reliever and helped me stay calm about the whole thing. Whatever your own hobbies are it is important to keep them up to some extent throughout the year, they're the best way of holding on to whatever sanity you might have left.

Even though it is, in a way, the most important year of your life-so-far it is important not to take the whole thing TOO seriously and keep things in perspective. There are an awful lot more important things to concern yourself with than exams and results. But in any case it is a milestone that must be passed at some stage.

Sleep and hydration are the two heaviest biological factors to be dealt with when it comes to study and exams. Your energy levels have to be at their peak at all times. It differs but I found I needed at least eight hours' sleep a night and about two and a half litres of water a day to function efficiently. It is also important to study at a time that suits you best. I found I could nothing after nine in the evening so I tried to do most of my weekend study in the mornings.

Study was never easy, and it never will be, but it does pay off in the end. Just remember that there's a life going on around you too and its there to be lived not studied.

SUCCESS AT UNIT 1 + UNIT 2 + MPAS
LEARN EVERYTHING LEAVING NOTHING OUT.

MANDATORY PRACTICAL ACTIVITIES (MPAS)

Unit 1

1. Conduct a qualitative test for starch, fat, a reducing sugar, a protein.
2. Using simple keys to identify fauna and flora.
3. Identify and use various apparatus required for collection methods in an ecology study.
4. Conduct a quantitative study of the plants and animals of a sample area of a selected ecosystem.
5. Investigate any three abiotic factors present in the selected ecosystem.

Unit 2

6. Be familiar with and use the light microscope.
7. Prepare and examine one animal cell unstained and stained using the light microscope.
8. Prepare and examine one plant cell unstained and stained using the light microscope.
9. Investigate the effect of pH on the rate of enzyme action.
10. Investigate the effect of temperature on the rate of enzyme action.
11. Investigate the effect of heat denaturation on the activity of one enzyme.

Higher Level Only

12. Prepare one enzyme immobilisation and examine its application.
13. Investigate the influence of light intensity on the rate of photosynthesis.
14. Prepare and show the production of alcohol by yeast.
15. Conduct any activity to demonstrate osmosis.
16. Isolate DNA from a plant tissue.

Unit 3

17. Investigate the growth of leaf yeast using agar plates and controls.
18. Prepare and examine microscopically the transverse section of a dicotyledonous stem (x100, x400)
19. Dissect, display and identify sheep's heart.
20. Investigate the effect of exercise on the pulse of a human.
21. Investigate the effect of I.A.A. growth regulator on plant tissue.
22. Investigate the effect of water, oxygen and temperature on germination.
23. Use starch agar plates to show the digestive activity during germination.

REVISION TECHNIQUE FOR MPAS.

Make out a list of 'short-answer questions' on each MPA.

Maybe write out the answers into a different section of you 'notes' having had the answers checked first for accuracy.

Make sure at the start of the set of questions to include some based on theory connected to the MPA because the first nine marks in a Section B question are for testing your background knowledge in the particular area of biology.

Given below is an example for MPA 12.

12. PREPARE ONE ENZYME IMMOBILISATION AND EXAMINE ITS APPLICATION.

Background Questions

1. What is an enzyme?
2. To what class of biomolecule do enzymes belong ?
3. Name the cell organelles at which the synthesis of enzymes takes place?
4. Synthesis of enzymes involves transcription and translation – state where each of these processes occurs in living cells.
5. What is the general shape of enzymes?
6. List two environmental conditions that affect the rate of enzyme activity.
7. Distinguish between a 'native enzyme' and a 'denatured enzyme'.
8. What is a 'renatured enzyme"?
9. What is the 'active site' of an enzyme?
10. Explain what is meant by stating that 'enzymes are specific'.
11. How do enzymes and substrates get to meet each other in living cells?
12. What is an immobilised enzyme?
13. Give one way that some enzymes are immobilised in living cells.
14. In industry immobilise enzymes are used in a bioreactor. What is a bioreactor?
15. Give one industrial application of immobilised enzymes.
16. Give two advantages of using immobilised enzymes in the industrial application.

Preparation of Immobilised Enzymes

17. Name the enzyme or enzyme source you used for immobilisation.
18. Name the solution that was mixed with the 'enzyme' solution.
19. What is the purpose to this second solution?
20. Why is it important to mix the two solutions gently?
21. Into what piece of apparatus was the mixture of the two solutions drawn?
22. Name the third solution into which the mixture was delivered one drop at a time.
23. What is the purpose of the third solution?
24. For how long are the gel beads kept in the third solution?
25. How are the gel beads separated from the third solution?
26. Why are the gel beads then washed with distilled water?

Examination of the Application of the Immobilised Enzyme

27. Name the substrate the enzyme acts on.
28. Name the enzyme specific to the named substrate.
29. Name the product of the reaction.
30. Into what type of container did you put the immobilised enzyme and substrate solution.
31. Did you use a control?
32. What is a control?
33. In what way did the control differ from the experiment set up?
34. At what temperature is the examination carried out?
35. How did you obtain and maintain this temperature?
36. How is the enzyme kept constant for the examination?
37. How is the substrate kept constant for the examination?
38. What test(s) did you carry out to check for enzyme activity?
39. How often is the test carried out?
40. How is the rate of enzyme activity measured in this examination?
41. Which was faster – immobilised enzymes or enzymes in solution?
42. How can the immobilised enzymes be easily separated from the product solution?
43. Can the enzymes in the control be easily separated from the product solution?
44. How may the immobilised enzymes be stored for future use?

There are two common versions of the examination of immobilised enzymes – one uses amylase to digest starch to maltose (reducing sugar) the other uses live yeast cells as a source of sucrase enzyme to digest sucrose to the reducing sugars glucose and fructose.

So here follows two questions, one specific to each version.

45. How will you know when the enzyme activity has stopped? (amylase version)

46. How do the control and experiment differ in turbidity (cloudiness). (yeast version)

MASTERING THE MPAS

Study the list of the MPAs above.

Mark the three you would hate to see on the exam paper in red. Study and learn these three MPAs this week – these are the three you fell you know least well and so need more study time than the others. The MPAs liked the least are the enzyme ones (9,10,11,12) plus 16 and 21.

Mark the five MPAs you would really like to see on the exam paper in green. Study these five on the fifth week of the MPA revision cycle – more than likely these will be the ones you have studied already at Junior Cert such as 1, 6, 7, 8, 20 and 22.

Challenge a 'friend' each week to quiz you on each of the MPAs revised that week.

To maintain the progress made each week you should also be quizzed on the MPAs revised the previous weeks.

This revision strategy will easily allow two complete revision cycles before the end of May and allow a final rapid revision before the biology exam.

Also ensure that you are able to draw a labelled diagram of the set up the apparatus for each MPA.

In 2006 the MPAs were worth almost 30% of the marks; last year almost 20%. Questions on the MPAs are not restricted to Section B of the exam paper sometimes appearing in Section A and every year in Section C. Given the value of the MPAs they should receive at least 20% of your biology revision time.

GET TO YOUR MPAS REVISION NOW!

Learn all 23 MPAs.

EXAM SUCCESS

1. Knowledge
2. Answering Skill
3. Confidence

Special offer today 'buy two get one free' – work on gaining the knowledge and answering skill and confidence (absence of exam stress) is automatically gained.

The knowledge is gained by blood, sweat and tears working hard in class and after class.

Answering skill is gained without taking up any extra time by the clever use of written homework.

With the knowledge and answering skill how can any exam cause trouble?

ANSWERING SKILL

'knowing how to use what you know'

Every day at least one written homework should be done under exam conditions – your brain is the only source of information, quiet, limited time – same as in an exam.

The written homework is based on what was covered in class – so work hard in class fully cooperating with your teacher for your benefit.

Revise before doing the written homework.

Then do the written homework under 'exam conditions'.

Any mistakes you make would be identical to those in an exam – everyone makes mistakes but the wise learn from them.

The mistakes will be either due to lack of knowledge or poor answering skill – not repeating these will definitely improve your answers on exam day.

IT PAYS TO RECHECK YOUR ANSWERS IN THE EXAM

The best strategy during the exam is to recheck each answer before starting the next question – it takes no more than 2 minutes to recheck a Section C question.

If you don't pick up on any mistakes then your answer is as perfect as you can make it. If you 'fix' any mistakes then you know that your marks will be better and you have not wasted your time especially when you consider it takes 2 hours 'study' to gain each of the 400 marks in biology.

Two hours for each mark? Yes. You spend a thousand hours in school each year and you are expected to do some more study after school.

SECTIONS A AND B ANSWERING STYLE

These are the fill-in questions – you write the answers on the exam paper in the spaces provided.
A usually sound guide is to try to make the answer fit the space.
To keep the answer brief do not repeat the question in your answer.
If you find that the space is not enough then continue the answer in a convenient place but indicate clearly to which part of the question the material is connected.

NEVER WRITE THE ANSWERS TO SECTION A AND SECTION B INTO THE ANSWER BOOK

The exam paper actually instructs you to write the answers to these sections onto the exam paper.

Some students try to keep a copy of their biology exam paper by writing the answers to section A and section B in their answer book.

This makes the 'markers' very angry as it makes their already difficult work much much harder.

You are very unwise to risk annoying the examiner.

Make sure you answer all six questions and every part of each question – **No Blank Spaces in Section A and Section B.**

SECTION C ANSWERING STYLE

Quite frequently a particular style of answer is required. You must answer in the style indicated.

Examples of Styles from Previous Exams.
Explain: make it clear and sensible with detailed information.
Distinguish between: point out the essential difference.
Name: just give the name and no other extra information.
Give an account of: give a detailed description or explanation of .....; it can be done in prose or diagrams with detailed labelling or a combination of the two.
Suggest: give a reasonable idea, hypothesis, explanation, purpose of, effect of etc. – the suggestion must be based on what you are expected to know from your study of the biology syllabus.
State: express fully and clearly in writing.
Describe: give a detailed explanation or report.
Draw a diagram: a written description will score zero – more on diagrams later.
Outline: short answer that includes only the major points – detail not required.
Briefly: short answer with the main point only – no time for detailed answers.
Write notes on: use prose, not diagrams, to give the information.
What is meant by: give a clear explanation.

OTHER INSTRUCTIONAL TERMS USED IN PREVIOUS EXAMS

Give a brief account of: the description or explanation must be short and contain the major points (minor details will not score marks).
Comment on:
Comment on the validity of: say whether the statement is true or false and then give reasons why it is true or why it is false.
Give an example of: it is important to give one example; if two are given and one of them is incorrect then the good one is cancelled by the wrong one; don't go for the spectacular example – always choose the easiest and the most familiar as it is much less likely to be wrong and will not have the 'corrector' having to check it out. Keep it simple.
List three methods of: just names needed – a list only, no marks for descriptions or explanations. Only describe or explain if you have forgotten the name.
What is meant by? Give an explanation or describe the purpose.