BOARD OF STUDIES
NEW SOUTH WALES

1998 HSC

EXAMINATION REPORT

Science 3/4 Unit

Published by
Board of Studies NSW
GPO Box 5300
Sydney NSW 2001
Australia

Tel: (02) 9367 8111

Fax: (02) 9262 6270

Internet: http://www.boardofstudies.nsw.edu.au

February 1999

ISBN 0 7313 4232 1

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1998 HIGHER SCHOOL CERTIFICATE

EXAMINATION REPORT

SCIENCE 3/4 UNIT

In 1998, 210 candidates presented for the 3 Unit paper and 515 candidates for the 4 Unit paper, making a total of 725, an increase on the candidature from 1997.

As in previous years, the general standard and quality of responses were wide-ranging. The standard of drawing still leaves much to be desired and students are again reminded that pencils, ruler and eraser should be used with care and precision. The correct use and conversion of units would help many students to improve their results, as would careful reading and analysis of each question before attempting to answer.

Students should be encouraged to give concise answers, taking into account the allocation of marks, particularly in the Electives Paper.

Responses also indicated that more time needs to be spent on the application of science (in particular physics) to everyday examples.

INTRODUCTION

The 3 and 4 Unit Science courses consist of a Core and Electives. The only difference between the two courses is that 3 Unit candidates do two electives while 4 Unit candidates do four electives, which must be chosen from three different disciplines. The common core contains material from Physics, Chemistry, Geology, Biology and Origins. Electives are written from Biology, Chemistry, Physics, Geology and Interdisciplinary studies.

The examination consists of two papers: the Core Paper (3 hours) and the Electives Paper (1.5 hours for 3 Unit and 3 hours for 4 Unit).

This is a rigorous and demanding Science course, which tends to attract a candidature of very competent Science students. Qualitative and quantitative elements of each topic are included in the Syllabus. Candidates need to be able to describe abstract concepts and phenomena as well as handle mathematical calculations. They are often examined on mandatory practical work, being asked to describe equipment required, techniques used and concepts illustrated by experimental procedures.

MARKING CRITERIA

In order to obtain a maximum spread of candidates, the Core Paper is marked out of 200 and each elective is marked out of 50. The marks are then halved. For example, candidates will generally be required, to supply six pieces of information to obtain full marks on a 3 mark question.

For questions involving mathematical calculations, candidates should show their transcription of information from the question, and state the formula being used (if applicable). All working should be clearly shown, together with statements explaining relevant reasoning. Answers involving vector quantities should always include both magnitude and direction.

No rounding off should occur until the end of a question, when the answer should be expressed in the appropriate number of significant figures.

Correct units must always be included in an answer.

Chemical equations should include states, where appropriate.

Diagrams should be clear, neatly and carefully drawn, in pencil, and be well labelled.

Straight sides of apparatus should be ruled with no gaps being shown at the corners. Diagrams of scientific equipment should be drawn in such a way that the procedure being illustrated would work and the relative size of each piece of equipment is reflected in the diagram.

Diagrams of natural phenomena must be believable. For example, volcanoes with slopes of 75˚, cells with membranes that cross and unjoined lines that represent pores where none should exist, may be penalised. Diagrams should be large enough to clearly show all relevant details.

Graphs must be of appropriate size on clearly labelled axes with units. Points should be accurately plotted, with small dots or crosses. Fine lines should be drawn as either a smooth curve or ruled, if a straight line is shown. ‘Feathering’ or thick lines are not acceptable. Graphs should be drawn in pencil.

When asked to ‘compare or contrast’, candidates would be well advised to use a table format. They should not assume that they can make a statement about one process or phenomenon and that the markers will provide the required corollary.

As a general guide, candidates should be encouraged to express answers in table form and to supplement them with appropriate diagrams. This applies to both the Core and the Electives.

PAPER I — CORE
SECTION I
MULTIPLE CHOICE

Science 3 Unit

	A	B	C	D
1	34.76	29.05	31.43*	4.76
2	32.86*	20.48	42.86	3.81
3	6.67	41.90	7.62	43.81*
4	9.05	58.10*	17.62	15.24
5	21.90	41.43*	21.90	14.76
6	43.33	11.90	43.81*	0.95
7	2.38	5.24	85.71*	6.67
8	34.29	42.86*	21.43	1.43
9	29.05	6.67	20.00	44.29*
10	19.05	8.57	6.67	65.71*

Science 4 Unit

	A	B	C	D
1	22.27	17.38	58.40*	1.95
2	42.97*	29.49	25.39	2.15
3	2.34	29.88	3.71	64.06*
4	4.49	69.92*	9.77	15.82
5	14.84	54.69*	16.80	13.28
6	25.20	5.08	66.99*	2.73
7	1.56	4.49	90.63*	3.32
8	17.77	63.28*	16.60	2.15
9	18.36	8.01	22.07	51.17*
10	11.52	3.31	6.05	79.30*

N.B. The correct response for each question is marked with an asterisk (*).

SECTION II

Question 11

(a) Most candidates were able to determine the number of moles of C, H and O in eucalyptol but a significant number could not find the simplest ratio.

(b) A small number of candidates showed no evidence of determining the empirical formula mass of eucalyptol.

(c) Those who were not able to calculate the correct number of moles of CO_2 produced through the complete combustion of 10.0g of eucalyptol did not balance an equation correctly nor recognise that 1 mole of eucalyptol produces 10 moles of CO_2.

Question 12

Candidates generally handled this well. The most common error was that of having too many figures in the answer.

Question 13

(a) A surprisingly large number of candidates could not correctly give the formula for galena, lead (II) sulfide and oxygen.

More than 25 incorrect formulae were noted. Others failed to balance the equation correctly, especially the oxygen. This suggests that candidates might have limited experience with equations where one of the reactants is in excess.

(b) The most common error here was the failure of candidates to address the 92.3% purity aspect of the sample. Others failed to convert correctly from one tonne to grams.

Most candidates could use the correct procedure to calculate the number of moles of PbS and then use the equation ratio to predict the number of moles of SO_2 .

The majority of candidates could convert the moles of SO_2 into volume of gas. A few candidates incorrectly used the value of 22.4 L $mo|^{-1}$ in the mole conversion.

(c) This part was generally well answered. Some candidates expected H_2SO_4 to be the product, others failed to indicate the physical states in the equation.

Question 14

(a) (i) Approximately half the candidates correctly identified metals E and J as being the strongest and weakest reductant respectively.

Common errors included reversing the two metals or using the salt solutions E and J.

(ii) This question was poorly answered by a majority of candidates. Although they could clearly express a reason(s) for the activity level of metal J, they frequently failed to record fully the two-step process which identified E as being the strongest reductant.

There was evidence of some confusion over the use of the term ‘reductant’.

(b) This part was poorly answered. When attempted, common errors included failing to balance the equation or putting nitrate ions into the ionic equation. Some candidates who gave confused answers in Section (a) were able to give the correct equation in this part.

Question 15

(a) Although most students thought $KE_{bottom} = mgh_{top}$, this part was generally well answered; many students, however, did unnecessary calculations of velocity.

(b) In the calculation of W = Fs. There was confusion as to the value of ‘s’. Many did not convert ‘em’ into ‘m’. The final force was given with magnitude by only 80% of the candidature.

Question 16

(a) Many students did not understand the significance of ‘line of best fit’ and incorrectly used a plotted point to determine the gradient. Many did not read the axes and missed the units (milli amperes).

(b) A number of students confused R_T with R in both (a) and (b) and then used the wrong value in the calculation of current, instead of reading it from the graph. Some had trouble adding resistors in parallel. There were unnecessary calculations of power in this section.

Question 17

(a) Many students calculated total current instead of answering the question. Most students recognised the kW conversion; a few, however, confused current with voltage in a parallel circuit. The majority knew the correct formula P = VI.

(b) This part was generally answered well, but some students did not show the working to support their answers although asked to do so in the question. Some students used power to justify their answer. Many used resistance (total) and having found R_T did unnecessary calculations as well as making the wrong decision as to which appliances to use.

Question 18

(a) Most students identified ‘gaps’ in the fossil records as being a major difficulty. While many could explain why the gaps occurred, very few were able to explain why this was such a problem for palaeontologists, ie lack of transitional forms to trace relationship.

(b) Many students were not awarded marks here because of inaccuracies in reading the graph. The majority answered ‘approximately 90%’, which is clearly the reading for 100 m years ago, not 115 m years ago, as requested.

(c) Most students realised that the half-life of C^{14} is too short or is limited to dating fossils 50-70,000 years old but they did not identify the age of this fossil as being outside the time-frame of C^{14} decay.

Question 19

The majority of candidates found difficulty in explaining a precise difference between combustion and cellular respiration eg although many could state that combustion produced heat and light and cellular respiration produced ATP, they forgot to mention that respiration also produces heat.

Also many candidates did not use correct scientific terminology in their answers to this question (eg stating spark or fire rather than ignition or temperature). Candidates were able to provide a variety of differences between combustion and cellular respiration. The concepts involved were, on the whole, fairly well understood. Many answers were poorly set out and organised, and very few candidates took the opportunity to use a table to answer the question.

Question 20

Many students did not analyse the whole question carefully so a number of students were distracted by the introductory sentence of the stimulus material and tended to discuss multicellular differentiation and cellular division, rather than the processes in the single-celled algae described.

In many responses students saw the example as referring to the expression of dominant and recessive genes, or mutation in a multicellular organism.

Few students were able to apply their knowledge of protein synthesis to the experimental situation.

SECTION III

Question 21

This question was generally well done.

(a) Few errors were made in answering this part.

(b) The most common error was to describe bonding rather than the structure of each compound in its solid state. The structure of P_4O_{10} was the least well understood. The question was, however, generally well answered.

(c) This part was well answered – the most common error was saying that P_4O_{10} was a conductor because 'it was polar'.

(d) Most candidates answered this part well.

Some described conduction in terms of 'electrons' – a significant conceptual error.

The most common error was failure to recognise that P_4O_{10} ionizes in solution and so would conduct a current.

(e) This was the least well done of the five parts.

The mention of pH led many students simply to give a pH value for the solutions rather than describing acid/base properties.

Question 22

(a) This was well done by the majority of candidates.

The most common error appeared to be ignoring the minus signs and, therefore, saying the MPs decrease down the group.

(b) This question was not as well handled.

Many candidates:

- confused intermolecular forces and intramolecular forces
- simply attributed increase in MPs to increase in mass
- explained the trend in terms of polarity/dipole-dipole
- explained the trend in terms of electronegativities.

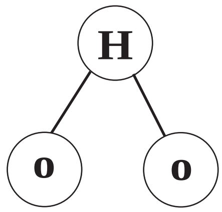
(c) (i) This question was very well handled.

The most common error was to name the intermolecular force exhibited by water as polar bonding.

(ii) This question was generally well done.

The most common errors were:

- drawing only one molecule, therefore no H-bond was shown
- drawing a molecule as that is O_2H



- reversing the charges on the atoms that is, $O^{\delta+}$, H^{-}
- diagrams either not labelled or poorly labelled.

(iii) This question was well answered.

- Most candidates gave hydrogen fluoride or ammonia as answers. Of those who gave molecular formulae for these, many gave an incorrect formulae, eg H_2F, NH_4.
- HCl was the most common incorrect answer.

Question 23

Very few candidates were able to score full marks for this question. This was largely due to errors in part (c).

(a) This question was generally well done.

Two common errors were:

- showing electrons on the wrong side
- showing oxygen being oxidised.

(b) (i) This question was not well done.

Most commonly candidates picked $Fe_2\,O_3$ (some even $Fe_3\,O_4$) or simply stated ‘carbon’.

A few said ‘oxygen’.

(ii) Of those who correctly identified CO as the reductant, few indicated the correct number of electrons.

The most significant errors occurred when:

- candidates selected either CO or $Fe_2\,O_3$ AND then stated NO electrons were transferred
- candidates indicated that a fraction of an electron was transferred.

(c) Few candidates appeared to possess the skills required to arrive correctly at a mole ratio for C:Fe. (The most common ratios stated were either 1:1 or 1:6. A significant number of candidates ignored the statement ‘10 tonnes of pure iron’ and found the number of moles in 10 tonnes of $Fe_2\,O_3$.

A large number of candidates, having arrived at a number of moles of carbon, took this to be moles of CO and proceeded to carry out a percentage composition calculation. This possibly shows that they did not understand the mole ratio of C to CO as being 1:1.

Question 24

(a) Most candidates correctly filled in the first column of the table. The common error here was failure to note that the time increments were 2s (candidates assumed time increments of 1s and wrote 2m distance increments).

Compared with the first column, a greater number of candidates filled out the second column incorrectly, ignoring the 48m starting displacement and going up in 8m increments.

The majority did not recognise that the skaters moved together after meeting at 16m. The positions of the dancers at 10s were most commonly given as if no collision had occurred, ie 20m for the female dancer and 12m for the male dancer.

(b) This section was generally well done, providing the table had been correctly filled out in part (a). A significant number of candidates did not state both the time and position as required – usually stating only the time.

(c) The best answers included a clear, general equation for momentum conservation and correct substitution, taking direction of velocity into account.

- Many candidates ignored velocity direction when substituting.
- A significant number made careless substitutions such as using the male's displacement (48m) as his mass.
- Some students tried to apply conservation of kinetic energy to solve the problem.

Question 25

(a) Most candidates were able to use the Law of Conservation of Energy to calculate the velocity of the diver as she enters the water.

(b) Most candidates realised that the work done by the water in decelerating the diver was equal to the energy change. Very few students, however, realised that the distance travelled in the water was also part of that energy change.

(c) The majority of candidates were able to use data from (b) to obtain their answer to this part.

Question 26

(a) The majority of candidates successfully calculated the voltage drop across the shunt resistor, but then had difficulty in determining the current flowing through the shunt resistor.

Conversion of units, particularly 'μ', caused difficulty.

(b) Most candidates recognised that the current drawn by the pilot lamp when operating was greater than the maximum current that can be measured by the ammeter. Some candidates came to an incorrect conclusion based on conversion errors.

(c) The majority of candidates were unable to give a suitable answer to this part. Vague use of terms such as 'current', 'power', 'potential difference', 'voltage' was widespread.

Question 27

(a) This part was generally well answered. A significant number of candidates did not grasp the relationship between the age of the crust and the time required for sedimentation to occur. In addition, some candidates indicated that the extruding magma pushes the sediment away or that the sediment is melted.

(b) Candidates had difficulty in answering this question satisfactorily. A significant number identified the symmetry about the mid-ocean ridge; the fact that the basalt was the same age throughout its depth was, however, not well understood. Also, the fact that the basalt under fossil 'F' was not the same age as 'F' was poorly understood. The age relationship was not well understood in that there is a new horizontal (age) layering in the sediments, yet a vertical layering in the basaltic sea floor.

(c) Most candidates understood that the asthenosphere is 'plastic' in nature, but often had difficulty in describing it adequately. Many candidates incorrectly indicated that it was molten/liquid or that it enabled the plates to slide. Convection currents were also described, but often not in connection with the lithosphere.

Question 28

(a) For those who had studied this area of biochemistry, this was relatively straightforward and full marks were gained. It was obvious, however, that many candidates simply guessed at an answer.

The biochemical reactions were often expressed as a part of the whole reaction.

(b) Only one anaerobic process was relevant here, namely glycolysis or chemical reaction Z. Those who had problems with part (a) generally had problems here as well.

(c) This was generally well answered, with most candidates correctly drawing the structural formula of ethanol. A small number of students incorrectly indicated on their diagram a double bond between carbon and oxygen atoms and some students were very careless in indicating how the OH molecule was attached, with the bond joining C and H rather than C and O.

SECTION IV

Question 29

(a) (i) Some responses here were inappropriate to the time mentioned, stating for example, bones. Some also cited a change which would not lead to increased fossilisation.

(ii) This part was generally well answered.

(iii) The majority of students did not stipulate that a ‘short time range’ referred to ‘geological’ time.

(b) (i) Some candidates did not specify that sedimentary layers must be undisturbed.

(ii) Candidates are reminded of the benefit of using diagrams to aid explanations. Many did not explain evolutionary theory by giving an example.

(c) (i) Candidates are reminded to apply the Darwinian theory of evolution to the specific example given in the question.

(ii) Few candidates were able to explain that species characteristics, such as courtship behaviour or body odour, prevent interbreeding between different species.

Question 30

(a) (i) Many candidates failed to recognise that V^{3+} is a reactant and so did not reverse the original equation.

Many were not able to select the appropriate half-equation for potassium permanganate from the data sheet and those who did so, were usually able to manipulate an equation for vanadium. A significant number of candidates either left electrons in the net-ionic equation or failed to remove the excess H^+ and H_2O from the relevant sides of the equation.

(ii) Candidates generally handled this well.

Use of the formula $\frac{C_1 V_1}{a} = \frac{C_2 V_2}{b}$ tended to cause confusion and is not recommended.

(iii) Those who failed to recognise this as a redox reaction did not appreciate the colour change and tended to confuse the titration with an acid-base titration – presumably as the permanganate was acidified.

(b) Relatively few candidates realised that one of the given reactions had to be reversed before E° values could be added.

(c) (i) This section of the question was generally well answered.

(ii) There was confusion between Faraday’s constant and Coulomb’s constant and many who used the charge on an electron failed to multiply by Avogadro’s number.

There were many ‘rounding off’ errors, with candidates carrying too few significant figures on to the next part of the question.

PART 2 – ELECTIVES

Question 1 – Flowering Plants and Mammals

1 (a)(i) This part was generally well answered, although some candidates did not mention that most plants close their stomates at night, and described only when they open.

(ii) There was a great variation in the quality of answers here.

- Students need to draw biological diagrams in pencil – many simply sketched in pen.
- Students need to draw a reasonably sized diagram – it should be at least 3 lines in size.
- They need to be reminded not to use shading and to draw firm closed lines.
- Labels often did not touch the relevant part (arrows must not be used).

(iii) This part was generally well answered. Candidates explained the need to conserve water and gave a relevant environment for crassulaceans to inhabit.

(b) (i) Good candidates related metabolic inhibitors to the need for ATP production and its use in active transport in the phloem. Many gave very detailed explanations for the effects of metabolic inhibitors on xylem and phloem.

Some candidates forgot to explain the effect of the inhibitors on conduction and simply explained the possible use of ATP by xylem and phloem (ie active vs passive transport).

(ii) Candidates were confused by the terms ‘transpired’ and ‘translocated’, even though they knew what was carried in the xylem and phloem as shown in part (i). Many talked about gases being carried. Some candidates discussed what was evaporated from the leaf (as transpiration).

(iii) Most candidates knew that they had to draw phloem tissue here but their drawings were poor. Some students forgot to draw companion cells.

(c) This question was generally well understood and well answered. Most candidates discussed the stimulus of light and the role of auxins in causing bending towards the light source. Some students talked about the plant elongating rather than its response at a cellular level. Many students used well labelled diagrams to illustrate their answers.

Some students confused the term ‘tropism’ with a stimulus.

(d) (i) This part was generally well answered. Most students knew that the greatest absorption of digestive products occurs in the small intestine. Some did not name the organ but named the structural feature of the villi.

(ii) The majority of candidates had no idea of what a mechanical characteristic aiding digestion was. Consequently this was a very poorly answered section. Many gave ‘enzymes’, or another structural feature as the answer.

Structural Characteristic was well answered. Most students discussed the villi increasing the surface area for absorption.

(iii) This part was generally well answered. Most candidates knew that triglycerides and the like move into the lacteals.

(iv) This question was poorly answered by most students who knew that fats go into the lacteals but did not know the reason.

(e) (i) This question was poorly understood and most candidates were confused to what was actually being asked. Many thought they simply needed to discuss concentration gradients rather than explaining why the decrease in blood level occurs.

(ii) Most students knew about bicarbonate ions and their bonding to haemoglobin. Some discussed the transportation of CO_2 by confusing it with CO (ie carboxyaminohaemoglobin). Many failed to discuss where this occurred (ie in plasma and red blood cells).

(f) (i) The majority of candidates were unable to produce a clear diagram to illustrate the steps and connections involved in a reflex arc of a mammal.

They frequently made diagrams too small or sketchy to show the necessary connections. Flow diagrams tended to show the steps more clearly. Many failed to include a stimulus and a response.

(ii) In general, this question was poorly answered. A number of candidates incorrectly assumed that the brain initiates the response in the reflex arc rather than understanding its secondary role after the reflex has occurred.

(g) (i) Most students answered this part correctly. A small number of candidates, however, compared fresh and used dialysis solution instead of fresh dialysis solution with blood entering dialysis.

(ii) Many students did not answer this question in sufficient detail.

(iii) Here candidates understood and explained ‘homeostasis’ well but illustrated their answers with poor examples (glucose), confusing blood glucose level (and control of same) as under kidney control.

Question 2 – Reproduction and Genetics

(a) (i) Although this question was generally answered well and many candidates were able to name three distinct forms of asexual reproduction, a number of students were unable to describe the process involved.

(ii) A number of candidates simply restated the question as part of their answer. Some did not comment on both sexual and asexual reproduction.

(b) Many candidates answered this correctly, but a number did not match the gametes with the right parents of the individual XXY.

(c) Most candidates answered this part well, although some showed a rather limited knowledge of restriction nuclease enzymes and only a superficial understanding of their role in recombinant DNA technology.

(d) (i) Many candidates did not refer to Mendel’s Law of Independent Assortment in answering this part.

(ii) Most candidates had a good understanding of the importance of crossing over and gave a satisfactory explanation of chromosomal behaviour.

(e) This question was generally well answered. Some candidates did not specify where fertilisation took place. The most common difference given referred to the different sites of fertilisation. Very few presented other differences such as laparoscopy or the chance of ectopic pregnancy.

(f) (i) This part was generally well done; many candidates, however, wrongly considered that no genetic variation can result from self-pollination.

(ii) Many candidates did not state an advantage of reproduction by cross-pollination, compared to self-pollination.

(g) (i) Most candidates understood that new liver cells were produced by mitosis.

(ii) Many candidates wrongly thought that the mutation in the liver cell would be inherited by any children born to the specific individual.

(h) (i) A number of candidates were not specific enough in their answers to this question.

(ii) Some did not mention both protein synthesis and DNA replication in answering this question.

(i) (i) Many candidates were unable to establish a relationship between virus and host. Some responses were very confused.

(ii) Candidates could not explain that undifferentiated cells and organ failure or deformity could more likely occur in an embryo than in an adult.

(j) (i) 1. There was a lot of misdirection in diagrams that failed to show exactly where fertilization occurs in plants.

2. This part was generally well answered.

(ii) Most answers here were good.

Question 3 – Micro-organisms and Disease

(a) (i) Most students could not correctly name the causative organism.

(ii) Candidates had difficulty in interpreting this question as it applied to the disease causing organism they had selected. They were confused by the term ‘life-cycle’.

(iii) Most answers here were good but too many lacked depth of understanding. Many did not outline the mode of transmission but simply used terms like ‘airborne’ or ‘contact’.

(b) (i) This part was answered well by most students although only a few noted the importance of sterilizing the agar medium. Some showed no evidence of having actually performed this operation.

(ii) The important biochemical methods of identification were rarely understood by the candidature.

(iii) Students ‘named’ rather than ‘discussed’ the importance of micro-organisms. Few related it to economic factors or provided an example.

(c) (i) Many candidates failed to recognise the fact that the antibodies in the serum were produced by the horses’ immune system. Answers were often too general and simply restated the question. Students tended to confuse the ‘bacterium’ used with the ‘disease’.

(ii) Most candidates indicated that memory cells confer long-term immunity. The majority, however, failed to mention that the antibodies in the serum eventually become inactive and do not last for long.

(iii) Most candidates recognised that the horse serum could be recognised as being foreign to the human body. Few, however, used the term ‘antigen’ or indicated that this would result in the serum being rendered ineffective.

(d) (i) The majority of students recognised endoplasmic reticulum and mitochondria but not structure ‘Y’. The function of endoplasmic reticulum was poorly understood.

(ii) Most students were able to recognise the electron micrograph as being from a eucaryotic cell and could clearly state the reasons for their classification.

(e) (i) This question was poorly answered. The majority of candidates did not recognise that T-Lymphocytes acted on infected host cells.

(ii) Most students recognised the role of antibodies in neutralising antigens and the promotion of phagocytosis. The role of the Complement System was, however, poorly understood.

(iii) Many students recognised the role of histamines in the inflammatory response but gave only a generalised description of the events that followed its release.

(f) (i) Most students understood the role of ‘selection’ in antibiotic resistance but tended to confuse ‘natural’ with ‘artificial’ selection.

Few students mentioned ‘multiple antibiotic resistance’.

(ii) Only a small number of students understood the mechanism of antibiotic action. Many mistakenly identified antigenic shift in viruses as being the reason for the ineffectiveness of antibiotics.

Question 4 – Co-ordination and Control

(a) Candidates successfully interpreted this question and answered it concisely.

(b) (i) Some mistook the target tissues thinking that the target tissue of insulin was blood.

(ii) It was difficult for some students to describe the interaction of homeostatic regulation of their chosen hormone.

(c) This was a good question and easy to interpret. The graph was probably helpful, but many candidates lacked the required depth of knowledge to answer the question.

(d) (i) Adequately labelled diagrams were drawn here.

(ii) This question was a discriminator, with the better students giving thoughtful answers.

(e)(i)-(iv) Candidates did not understand part (iv) as well as the other parts.

(f)(i)-(ii) Despite the italics in the question, candidates did not relate it to ‘dwarfism’.

(g)(i)-(ii) Part (ii) elicited some interesting and thoughtful responses.

(h) (i) This type of question should have been well answered but was not. Candidates appear to have very poor experimental design skills.

(ii) This part was better done because of the wording of the question.

Question 5 – Energy

(a) (i)1. Candidates handled the MCDC calculation well, but failed to complete the calculation for 1 mole of NaOH.

2. This part was poorly done by most candidates who failed to recognise the difference between melting and dissolving in terms of bonding.

(ii)1. Many candidates experienced difficulty with this part as they could not write the equation for complete combustion of tristearin correctly.

2. and 3. These parts were answered well.

(iii) These parts were generally answered well.

(b) (i) Many candidates failed to reverse the equation to show the oxidation reaction at the nickel electrode while it is being recharged.

(ii)-(iv) Most candidates showed a good understanding of electrochemical cells. Electrolytic cells, however, were not as well understood.

(c) Most candidates handled all parts of this question well.

(d) (i) The majority of candidates could list environmental problems, but were unable to describe why they were problems.

(ii)-(iii) These parts were well done.

(e) (i) and (ii) Equations here were poorly balanced.

Few candidates put C(s) as a product in the sooty flame.

(iii) and (iv) These parts were also well done.

(v) Most candidates were able to identify butanol with the higher ignition temperature, but few explained it in terms of bonding. Most referred to higher molecular mass.

Question 6 – Atomic Structure and the Periodic Table

(a) This part was generally well done except for (iii) where few candidates were familiar with Chadwick's experimental work and the equipment used.

(b) This was generally well done, although some problems occurred with

(i) balancing equations and writing nitrogen as N_2(g)

(ii) Some candidates gave groups rather than blocks.

(iii) Some misreading of the question occurred here and the electronic configuration of 'atoms' not 'ions' was given.

(iv) Insufficient detail was given in answers. Candidates simply wrote that B was a metal instead of explaining why it did not react.

(c) Some problems occurred in students' interpretation of this question.

(i) Many candidates described Thomsons 'plum pudding model' instead of his contribution to the understanding of electron behaviour.

(ii) and (iii) Much better descriptions of the work of Bohr and Heisenberg were given.

(d) (i)1. The differences between shells, subshells and orbitals were not well described.

Many candidates failed to mention energy in their answer or to use oxygen as their example.

2. Diagrams were sometimes carelessly drawn and on occasions, all 3 'p'-orbitals were illustrated; sometimes candidates just gave the 1 'p' orbital to represent the subshell.

(ii) This part was well answered.

(iii) Few full explanations were given for why calcium will not readily form compounds containing Ca^{3+} or Ca^{+} and ionisation energies were rarely mentioned. Most answers concentrated on why Ca^{2+} ions formed rather than why Ca^{+} and Ca^{3+} ion did not.

(iv) This part was well answered.

(v) This part was also well answered.

(e) (i) Few candidates described arrangements of tables in terms of periodic law; most simply stated that Mendeleev's table was set out in order of atomic mass and the modern table in order of atomic number.

(ii) (1 and 2) Answers to the two parts of the question were very similar, with very few specific distinctions being drawn.

(f) Recall of information for this question was sound.

Question 7 – Carbon Chemistry

(a) (i) and (ii) These two parts were generally well answered.

(iii) Those who overlooked 'two organic products' in the stem of the question commonly chose 1-pentene, rather than 2-pentene, as compound A.

Many did not take the oxidation to its final products, while some did not recognise the fact that A would cleave at the double bond.

(iv) While many candidates were able to add across the double bond, a number failed to see that this produced two organic products and that $H_2(_g)$ was a common second product.

(v) This part was generally well done, although a significant number of candidates failed to write a complete equation, omitting NaBr as a product.

(v) The main problem here was the need to join a '-COOH' group to a secondary alkanol to form the ester. Water was often omitted as a product.

(vii) Here the main error was failing to indicate the position of the double bond in the name.

(viii) In answering this part, candidates should have specified the metal catalyst required.

(b) (i) and (ii) Both these parts were well answered.

(c) (i) Candidates handled reactions 2 and 4 well.

Reactions 1 and 3 seemed less familiar, and the type of reaction in 3 proved most difficult for many to name.

(d) (i) Although candidates were generally able to handle esterification well, errors were made here in drawing such a large molecule. Water was again often omitted from the products.

(ii) Most candidates knew that H_2SO_4 is the required catalyst, but many did not specify 'concentrated'.

(iii) The majority of candidates realised that for refluxing the condenser needs to be in the upright position. Many candidates were unable to draw a condenser sitting snugly in the neck of a flask and many chose, instead, to draw an inappropriate long–necked flask (surrounded by a water jacket) but impossible to fill. Many condensers had no top to them and would have failed to retain the cooling water.

(iv) This part was well handled by many candidates.

(v) Some students confused the distillation process with the reflux process and gave a similar answer here.

(vi) Products here were not well named. Many students thought that the reaction made soap.

General comments

1. Candidates were proficient at naming the structures they drew.
2. Candidates should ensure that each ‘C’ has the correct number of bonds and that all bonds and hydrogens are shown.

Question 8 – Regional Geology

(b) In answering this question two investigative techniques were required. Most candidates explained one reasonably fully, although specific examples were lacking in many cases. The second example was generally answered superficially, with generalisations rather than specific detail relating to the Sydney Basin.

(c) (i) The drawing of a map of the region was well done by almost all candidates.

(ii) Many candidates knew one type of igneous lithology but not another.

(iii) A number of candidates failed to explain the origin of the magma.

(d) (i) Many cross sections drawn here looked more like a geological column. They failed to show major topographic features as well as the basement structure.

(ii) Most candidates chose a stratigraphic unit rather than a structure.

(iii) A number of candidates were unsure of the ages of the formation of the structure, although they knew the age of the lithologies involved.

(e) (i) Whilst most candidates could reconstruct a stratigraphic column and correctly label the major formation or group, very few gave the dominant lithology for each of the groups.

(ii) Most could draw a vertical line through their east-west cross-section in part (c) and (d).

(iii) The majority could name a fossil, its lithology and depositional environment.

(f) (i) Most candidates could name two regions adjoining their region of study.

(ii) The majority of candidates could not give the age of rocks from the boundary surrounding their region.

(iii) Many candidates could give the tectonic relationship for one region but not the other.

Generally candidates appeared to be confused about many of the terms used in the syllabus such as stratigraphy, structure, lithology, topography.

Question 9 – Mountains

(a) (i) A surprising number of candidates did not copy the profiles given into their answer books and made up variations on the theme. Type I, shield volcanoes, were often dome-like in profile, and many incorrectly considered the Type I profile to be not a volcano but a section through a mid-ocean ridge. Many could not view the profiles as being individual volcanos and had exaggerated subduction zones with spreading centres beneath them.

(ii)1. Accepted terms were Type I – shield, Type II – composite or strato-volcano. A significant number of students mistakenly called the composite cone a scoria cone or cinder cone.

2. This part was generally well answered, with the key words of Type I – basalt and Type II – andesite being generally well known. The viscosity of the lavas was less well understood.

3. Too many inappropriate adjectives were used to describe volcano activity eg gentle, quiet, passive, non-violent, not explosive.

(iii) This was poorly answered with poor geographic skills being very apparent. There was considerable confusion about names of volcanos and their types.

(iv) This was very poorly handled, with many candidates failing to specify two beneficial consequences and two harmful consequences to specific volcanic eruptions.

(b) (i) This question was poorly answered.

Candidates were required to explain that marine fossils were buried by muds on the ocean floor. Most candidates correctly described the folding and uplift of these sedimentary rocks to form the Himalayas.

(ii) Many cross-sections drawn were unlabelled. Many diagrams were inaccurate and difficult to interpret.

(iii) This question was generally well answered.

(c) A large number of candidates failed to discuss natural hazards such as earthquakes, rock slides and avalanches but, instead, were distracted by the hazards faced by skiers and rock climbers.

(d) This question is similar to those asked on past papers and was therefore well done.

(e) Most candidates knew the location of only one shield region in the world.

Question 10 – Electromagnetism

(a) This question was answered reasonably well. The majority of students did not realise that the earth's field deflected oncoming charged particles away from the atmosphere above the equator and towards the polar regions where they interact with gases to produce light.

(b) (i) This question was generally well answered, with a small minority indicating downward, rather than upward deflection, suggesting a lack of understanding of electric field direction and its relationship to the force on a positive charge.

A very small number of students gave answers involving circular/spiral motion suggesting confusion between the effects of electric fields on charged particles as opposed to the magnetic field effects.

(ii) The question implied that a verbal response was required ('Explain') and students had great difficulty in accurately and unambiguously describing the positions of the coils – clearly a problem stemming from the difficulty in describing the location of the cells in 3-dimensions, complicated by the possible orientation of the coil's poles and/or the direction of currents in the coils. Those who used diagrams answered the question better, although there were problems in representing 3-D information in 2-D. There were many possible correct solutions to this question.

(c) (i) The majority of students were able to adequately explain the functions of the individual motor components. Fewer related those functions in a way which explained how the motor worked.

The function of the brushes was least well described, with many students failing to explain their role in maintaining electrical contact between MOVING parts of the motor and STATIONARY parts.

Unfortunately, many students brought in the concepts of flux change, indicating that they are confused by motors, back emf, and generators.

(ii) Most students interpreted this question by explaining why the power output of an electric motor is less than the power input – heat losses due to current in resistive coils and friction in bearings.

Those who attempted to explain the effect of back emf on the motor's function generally gave confusing explanations.

A significant number of students gave very confused responses when they attempted erroneously to relate back emf to energy losses.

(iii)1. Most students were able to apply $F = nBI\ell$ without difficulty.

Some added a 'sinø,' factor to the equation but did not realise that the relevant section of the conductor was perpendicular to the field, despite the orientation of the coil's plane.

Students commonly omitted to take into account the number of turns.

Calculation of the length of the coil's side, given the area, also presented difficulties for some.

2. The concept of torque was well understood by the majority of candidates. A significant number did not convert cm^2 into m^2 as required for correct SI unit use.

The majority stated answers with correct units of NM.

(d) (i) The concept of Faraday's Law was well understood by most candidates.

(ii) A significant number of students were unable to express principles/laws verbally. Many resorted to quoting memory aids such as the 'right hand rule' or 'slap rule' rather than explaining principles as required by the questions.

(iii) A number of students referred to induced currents in the metal object but did not relate this to the resulting field's varying the flux through the receiver coil hence inducing a current.

General comments

Student are advised to avoid writing statements in inverted commas – the exact meaning should be clearly given.

Question 11 – Oscillations and Waves

(a) Most candidates were able to determine which thrower gave the discus the greater centripetal acceleration. The most common mistake was in the calculation of frequency or period.

(b) (i) Some candidates had difficulty in recalling the appropriate relationship between two specific atoms. A few confused 'frequency' with 'force' in the equation $F = -kx$. The units for the force constant were often stated incorrectly.

(ii) Most candidates were able to calculate the maximum magnitude of force acting on the vibrating gold atom.

(iii) Many students incorrectly used equations for 'work' or 'gravitational potential energy'.

(iv) The majority of candidates recognised the point in the vibration cycle where the gold atom experienced the maximum PE.

(c) (i) and (ii) A number of candidates showed their understanding of amplitude and frequency.

(iii) Many candidates gave poorly expressed responses. A common answer referred to the addition of wave amplitudes.

(iv) The majority of candidates had little difficulty in adding the waves together.

(d) (i) A number of candidates did not fully describe the type of wave produced.

(ii) Most were able to read the appropriate value from the graph.

(iii) Most candidates successfully substituted the converted wavelength into the relevant equation.

(iv) Although many candidates drew appropriate diagrams, many others did not understand the term 'fundamental mode'.

(v) Almost all candidates represented a standing wave in a string fixed at both ends. Many, however, were unable to draw the third harmonic correctly.

(vi) The majority of candidates were able to determine the wavelength of the standing wave they had drawn.

(vii) Candidates were not concise in their responses which gave a wide range of interpretations for the term ‘requirements’.

(viii) This part was poorly answered by many candidates. Few could describe the relationship between the motion of the string and the air.

(e) (i) and (ii) Both parts of this question were poorly answered by all candidates, who appeared to be confused about what was being asked in each part.

No candidates were able to describe correctly the path of the light rays. Many related the dark and light areas to the troughs and crests visible in a water wave tank. A number of candidates described diffraction effects to explain the pattern.

Question 12 – Light

(a) It was obvious that many students had not encountered the problem stated in the question and found it difficult. Many did not know that the image should be behind the mirror. Others who knew where the images should be located failed to use intersecting rays and were penalised.

(b) (i) The majority of students were able to find the correct refractive index here.

(ii) This question consisted of three parts; the first two were straightforward and most students were able to determine correct values for (r) and (i).

Part 3 confused many students who obviously spent a lot of time working through the trigonometry.

Some students assumed, incorrectly, that angles (i) and (r) were small enough to use the relationship:

$$\frac{\text{True Depth}}{\text{Apparent Depth}} = \text{Refractive Index}$$

(c) This question confused many students and many could not solve the problem at all. Method 1 Scaled diagram.

A number of students failed to draw an accurate ray diagram and did not know which rays to use in order to locate the focus.

Many students did not use the relationship r = 2f and d = 2r.

Method 2

Many students who tried to use the mirror formula $\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$ either forgot to invert at the end or used object and image size rather than object and image distance obtained from the magnification formula.

Question 12 – Light

(d) (i) and (ii) These parts were usually well done.

(iii)1. Many candidates failed to recall the preliminary equation W=qV and tried to calculate the kinetic energy by using the mass of the electron travelling at the speed of light. Answers here were poor.

2. This was better attempted than the previous part and most could recall either E=hf or V=fλ but failed to put the two together to derive the wavelength. Some had v as the speed of the electron rather than the x-ray.

(e) Most could recall Einstein's relation particle nature and Huygens' principle wave nature of light but failed to explain why their properties led to the incompatibility.

(f) Most candidates knew that a polarising filter reduced the intensity of light by limiting the vibration of the light to one plane but did not know that reflected light from water is partially polarised.

Question 13 – Biochemistry

(a) (i) Here the majority of candidates correctly named the molecules described.

(ii) A large number of candidates could not answer this question.

(iii) While most candidates gained marks here, the descriptions of the tests were poor.

Paper is turned translucent by lipids – not transparent or clear.

(b) (i) and (ii) Most candidates gave correct responses here although there was some inaccuracy in the selection of types of bacteria.

(iii) Although most candidates realised that nitrogen was necessary for amino acids, nucleic acids etc, many failed to relate this to metabolism.

(c) (i) and (ii) This question was generally well answered. Many candidates, however, did not refer to triplet codes. Candidates are encouraged to list events (eg in protein synthesis) in point form for greater clarity.

(d) (i) The required equations were poorly done. Candidates need to be more accurate in their representations of biochemical events, eg H_2 is not a product of photolysis.

(ii) Most candidates were aware that the oxygen formed in photolysis comes from the water.

(e) (i)-(ii) Structural formulae were well done. Some candidates, however, gave the formula for glycine.

(iii) Few candidates were able to explain Chelation.

(f) Many candidates failed to note that there are no organelles in red blood cells.

Those who did note this fact performed well in this question. An equation summarising energy production must include ATP.

(g) (i) This part was generally quite well answered – students referred to specificity and showed a good understanding of active sites.

(ii) While most candidates could account for the increase in rate from A to B, only a small number accounted for the levelling off above 5mM glucose concentration in terms of limiting factors.

(iii) Few candidates described a relationship; most simply said the reaction would be slower.

(iv) Those who realised that the enzymes described performed optimally under different conditions gained marks here.

Question 14 – Photography

(a) Most candidates recognised the correct choice of film, lens aperture, exposure time and accessory for each scene. The most common mistake was confusing speed and lens opening.

(b) The majority of candidates were able to give a correct difference between depth of field and depth of focus. In some cases, however, diagrams were confusing and missing from answers even though the question asked for them.

(c) Most candidates were able to calculate the correct lens aperture.

(d) The majority of candidates showed good knowledge of the image information by a convex lens.

(e) Most candidates were able both to name and explain two photographic techniques used in the life sciences.

(f) A large number of candidates were able to give a suitable explanation about an infra-red photograph and its ability to give more detail than a normal photograph.

(g) All parts were well answered by the majority of candidates. The most common areas causing confusion were indicating how developing has improved the photographic process and the role of fixing a black and white film.

Question 15 – Physics in Medicine

(a) Students scored well in this question.

(i) Marks were lost in part (i) by those who said that γ radiation came from the β particles.

(ii) Again this part was generally well done but many did not discuss penetrating properties of β particles.

(iii) Almost all students answered this part correctly.

(iv) Answers here were very good.

(b) Since this was a straight forward question, most candidates scored full marks.

(c) (i) Imprecise explanations cost both marks and time. Many wrote about ultrasound being used for density analysis of tissue. Few really understood the mechanism involved in the process.

(ii) A small number of students completed the calculation correctly. Most did not realise that f_r was f±95.

Many substituted wrongly for C and F.

Some regarded c as being speed of light.

(d) (i) Most students drew the correct layout of manometer, cuff, pump but drawings were very poor. Biros were used, labelling was unclear and proportions were quite wrong.

(ii) Only a very small number of students had any idea about an automatic sphygmomanometer so that most wrote about the manual one they had drawn.

(e) Students did not confine their answers to the appropriate sections (i), (ii) or (iii). This meant that their answers were often repetitive.

NMR imaging was well understood but few students clearly explained the movement of both X-ray sources of the detector in the CAT scanner.

(ii) The function of computers in relation to and the process of NMR was not understood. Candidates only understood how computers are used to produce, vary and store the images.

(iii) This part was very well done.

(f) This question was very well answered, with most students scoring full marks.

(g) (i) Internal reflection was very well explained both as a written text and diagrammatically. Not one student mentioned the differences in refractive indices of the fibre and its surround.

(ii) Many students (40%) confused coherent bundles with coherent light. Few drew a diagram of a coherent bundle.

Question 16 – Space Science

(a) (i) Students did not seem prepared for this question. Few knew much about V2 rockets.

(ii) Only one student knew of V2's fuel.

(iii) Candidates were better acquainted with Robert Goddard and most knew of his gyroscopes.

(b) The majority of students had some idea about Cesium being ionised and repelled out of the rocket.

Few wrote about the positive grid that caused this repulsion.

(c) This part was generally very well answered.

(d) (i) This part was both well understood and well described.

(ii) Few candidates explained the underlying Physics involved here; half merely described the equations.

(iii) About half the number of candidates attempted this task but few (6) completed it. T was seldom expressed in seconds.

(e) (i) Most candidates scored full marks for this part.

(ii) Some made other inferences than those implied by the discovery mentioned in (i).

(f) (i) Only half the students understood the effects of *g* forces during take off. Poor expression lost marks here.

(ii) This part was very well answered. Most candidates scored some marks for describing the heat shield or parachutes.

ISBN 0 7313 4232 1